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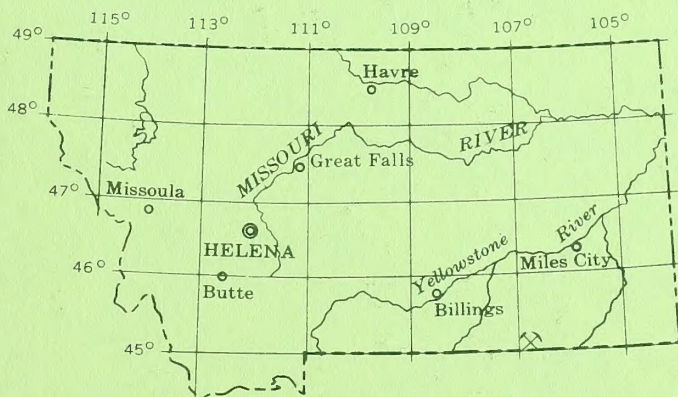
FINAL
ENVIRONMENTAL IMPACT STATEMENT

PROPOSED PLAN OF
MINING AND RECLAMATION
PLEASE RETURN
EAST DECKER AND NORTH EXTENSION MINES
DECKER COAL COMPANY
BIG HORN COUNTY, MONTANA

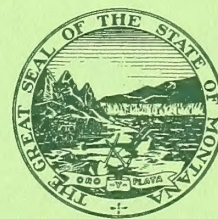
VOLUME II, APPENDICES

STATE DOCUMENTS

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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



STATE OF MONTANA
DEPARTMENT OF STATE LANDS

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U.S. DEPARTMENT OF THE INTERIOR
MONTANA DEPARTMENT OF STATE LANDS

FINAL
ENVIRONMENTAL IMPACT STATEMENT

PROPOSED PLAN OF MINING AND RECLAMATION
EAST DECKER AND NORTH EXTENSION MINES
DECKER COAL COMPANY
BIG HORN COUNTY, MONTANA

PREPARED BY

U.S. Geological Survey, Department of the Interior
Montana Department of State Lands



Commissioner
Montana Department of State Lands



Director
U.S. Geological Survey



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APPENDIX A

LEASE COPIES

APPENDIX A

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

DEC 15 1953
BILLINGS, MONTANA

Office Montana
Serial No. 06770

NOTED
DEC 11 1953
H. I. SMITH

LEASE OF COAL LANDS UNDER THE ACT OF
FEBRUARY 25, 1920, AS AMENDED

This lease, entered into on January 1, 1954, by the United States of America, the lessor, through the Bureau of Land Management, and Leslie C. Sharp, 812 Marion Street, Sheridan, Wyoming,

the lessee, pursuant and subject to the terms and provisions of the act of February 25, 1920 (41 Stat. 437), as amended, hereinafter referred to as the act, and to all reasonable regulations of the Secretary of the Interior now in force which are made a part hereof,

WITNESSETH:

SECTION 1. *Rights of lessee.*—The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth, does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all the coal in the following-described tracts of land, situated in the State of Montana

T. 8 S., R. 40 E., P.M., Montana
Sec. 33, 35, 36

By Hand

DEPT. OF LAND MANAGEMENT
LAND OFFICE
BILLINGS, MONTANA

AUG 10 1953

containing 20 acres, more or less, together with the right to construct all such works, buildings, plants, structures, and appliances as may be necessary and convenient for the mining and preparation of the coal for market, the manufacture of coke or other products of coal, the housing and welfare of employees, and, subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted.

SEC. 2. In consideration of the foregoing, the lessee hereby agrees:

(a) *Development and expenditure.*—To diligently develop the land leased by expending in actual mining operations, development, or improvements upon the land leased, or for the benefit thereof, the sum of Two hundred dollars dollars, of which sum not less than one-third shall be so expended during the first year succeeding the execution of this lease and a like sum during each of the two succeeding years, unless sooner expended; and to submit at the expiration of each of the three years an itemized statement of the amount and character of said expenditure during such year.

(b) *Bond.*—To maintain the bond furnished upon the issuance of this lease, which bond is conditioned upon compliance with all the provisions of the lease, and to increase the amount of or furnish such other bond as may be required.

(c) *Rental.*—To pay the lessor annually, in advance, for each acre or part thereof covered by this lease, beginning with the date hereof, the following rentals: 25 cents for the first year, 50 cents for the second, third, fourth, and fifth years, respectively, and \$1 for the sixth and each succeeding year during the continuance of the lease, such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid.

(d) *Royalty.*—To pay the lessor a royalty of fifteen cents on every ton of 2,000 pounds of coal mined during the first 20 years succeeding the execution of this lease. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

(e) *Minimum production.*—Beginning with the fourth year of the lease, to mine and pay a royalty on the basis of a value of \$1.00 per ton of coal per year, except when operations shall be interrupted by strikes, the elements, or casualties not attributable to the lessee, or unless on application and showing made, operations shall be suspended when market conditions are such that the lessee cannot operate except at a loss or suspended for the other reasons specified in section 39 of the act. Operations under this lease shall be continuous except in the circumstances described or unless the lessee shall pay a royalty, less rent, on such minimum amount of coal, for one year in advance, in which case operations may be suspended for that year.

(f) *Payments.*—Unless otherwise directed by the lessor, to make rental, royalty, or other payments to the lessor, to the order of the Treasurer of the United States, such payments to be tendered to the manager of the land office for the district in which the lands are situated, or, for States in which there is no land office, to the Director, Bureau of Land Management, Washington 25, D. C.

(g) *Plats, reports, maps.*—At such times and in such form as the lessor may prescribe, to furnish a plat showing development work and improvements on the leased lands and a report with respect to stockholders, investment, depreciation, and costs. To furnish in such form as the lessor may prescribe, within 30 days from the expiration of each quarter a report covering such quarter, certified by the superintendent of the mine, or by such other agent having personal knowledge of the facts as may be designated by the lessee for such purpose, showing the amount of leased deposits mined during the quarter, the character and quality thereof, amount of its products and byproducts disposed of and price received therefor, and amount in storage or held for sale. To keep and prepare maps of the leased lands in accordance with the regulations in 30 CFR, Part 211.

(h) *Weights.*—To determine accurately the weight or quantity and quality of all leased deposits mined, and to enter accurately the weight or quantity and quality thereof in due form in books to be kept and preserved by the lessee for such purposes.

(i) *Inspection.*—To permit at all reasonable times (1) inspection by any duly authorized officer of the Department, of the leased premises and all surface and underground improvements, works, machinery, equipment, and all books and records pertaining to operations and surveys or investigations under this lease; and (2) the lessor to make copies of and extracts from any or all books and records pertaining to operations under this lease, if desired.

(j) *Assignment of lease or interest therein.*—To file for approval with the office prescribed in the regulations, within 90 days from the date of final execution, any assignment, sublease, or transfer made of this lease, whether by direct assignment, working agreement, transfer of royalty interest, or otherwise. Such instrument will take effect the first day of the month following its final approval by the Director, Bureau of Land Management, or if the assignee requests, the first day of the month of the approval.

(k) *Nondiscrimination.*—Not to discriminate against any employee or applicant for employment because of race, creed, color, or national origin, and to require an identical provision to be included in all subcontracts relating to operations on the leased land.

(l) *Lands disposed of with the coal deposits reserved to the United States.*—If the lands embraced herein have been or shall hereafter be disposed of under laws reserving to the United States the deposits of coal therein, to comply with all conditions as are or may hereafter be provided by the laws and regulations reserving such coal.

(m) *Operations, wages, freedom of purchase.*—To comply with the operating regulations (30 CFR, Part 211), to exercise reasonable diligence, skill, and care in the operation of the property, and to carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health or property, and of waste or damage to any water or mineral deposits; to fairly and justly weigh or measure the coal mined by each miner; to pay all wages due miners and employees, both above and below ground, at least twice each month in lawful money of the United States; to accord all miners and employees complete freedom of purchase; to restrict the workday to not exceeding eight hours in any one day for underground workers, except in cases of emergency; to employ

no boy under the age of sixteen and no girl or woman, without regard to age, in any mine below the surface; unless the laws of the State otherwise provide, in which case the State laws control.

(n) *Taxes.*—To pay when due, all taxes lawfully assessed and levied under the laws of the State or the United States upon improvements, output of mines, or other rights, property, or assets of the lessee.

(o) *Overriding royalties.*—Not to create, by assignment or otherwise, an overriding royalty interest in excess of 50 percent of the rate of royalty first payable to the United States under this lease or an overriding royalty interest which when added to any other outstanding overriding royalty interest exceeds that percentage, excepting, that where an interest in the leasehold or in an operating agreement is assigned, the assignor may retain an overriding royalty interest in excess of the above limitation if he shows to the satisfaction of the Director, Bureau of Land Management, that he has made substantial investments for improvements on the land covered by the assignment.

(p) *Delivery of premises in case of forfeiture.*—In case of forfeiture of this lease, to deliver up to the lessor in good order and condition the land leased, including all buildings, and underground timbering and such other supports and structures as are necessary for the preservation of the mine or deposit.

SEC. 3. The lessor expressly reserves:

(a) *Rights reserved.*—The right to permit for joint or several use such easements or rights-of-way, including easements in tunnels upon, through, or in the land leased, occupied, or used as may be necessary or appropriate to the working of the same or other lands containing the deposits described in the act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

(b) *Disposition of surface.*—The right to lease, sell, or otherwise dispose of the surface of the leased lands under existing law or laws hereafter enacted, insofar as said surface is not necessary for the use of the lessee in the extraction and removal of the coal therein, or to dispose of any resource in such lands which will not unreasonably interfere with operations under this lease.

(c) *Monopoly and fair prices.*—Full power and authority to promulgate and enforce all the provisions of section 30 of the act to insure the sale of the production of said leased lands to the United States and to the public at reasonable prices, to prevent monopoly, and to safeguard the public welfare.

(d) *Readjustment of terms.*—The right reasonably to readjust and fix royalties payable hereunder and other terms and conditions at the end of 20 years from the date hereof and thereafter at the end of each succeeding 20-year period during the continuance of this lease unless otherwise provided by law at the time of the expiration of any such period. Unless the lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for a 20-year period, he will be deemed to have agreed to such terms.

(e) *Waiver of conditions.*—The right to waive any breach of the conditions contained herein, except the breach of such conditions as are required by the act, but any such waiver shall extend only to the particular breach so waived and shall not limit the rights of the lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this lease for any other cause, or for the same cause occurring at another time.

SEC. 4. *Reserved materials.*—Pursuant to the provisions of the act of August 1, 1946 (60 Stat. 755, 42 U. S. C., secs. 1801-1819), all uranium or thorium, or other materials which have been or may hereafter be determined by the Atomic Energy Commission to be peculiarly essential to the production of fissionable materials, contained in whatever concentration in the lands subject to this lease, are hereby reserved for the use of the United States, together with the right of the United States through its authorized agents or representatives at any time to enter upon the lands and prospect for, mine, and remove the same, making just compensation for any damage or injury occasioned thereby. The lands subject to this lease may be used as if no reservation of the above-named materials had been made; except that, when such use results in the extraction of any such material in quantities which may not be transferred or delivered without a license from the Atomic Energy Commission in accordance with such procedures as the Commission may establish, such material shall be the property of the Commission and the Commission may require delivery of such material to it by the lessee or by any possessor thereof after such material has been separated as such from the ores in which it was contained. If the Commission requires the delivery of such material to it, it will pay to the lessee or to such other person as the Commission determines to be entitled thereto, such sums, including profits, as the Commission deems fair and reasonable for the discovery, mining, development, production, extraction, and other services performed with respect to such material prior to such delivery, but such payment will not include any amount on account of the value of such material before removal from its place of deposit in nature. If the Commission does not require delivery of such material to it, the reservation contained in this lease will be of no further force or effect.

SEC. 5. *Relinquishment of lease.*—Upon payment of all rentals, royalties, and other debts due and payable to the lessor, and upon payment of all wages or moneys due and payable to the workmen employed by the lessee, the lessee may surrender the entire lease or any legal subdivision or subdivisions of the area included within the lease, upon a satisfactory showing that the public interest will not be impaired. In no case will such lease be so terminated in whole or in part until and unless the lessee shall have made provision for the preservation of any mines or productive works or permanent improvements on the lands covered thereby. A surrender must be by a relinquishment filed, in triplicate, in the proper land office. A relinquishment upon its acceptance shall take effect as of the date it is filed.

SEC. 6. *Protection of the surface, natural resources, and improvements.*—The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) Causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the United States or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the surface of the leased land to its former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the United States and improvements thereon.

SEC. 7. *Removal of equipment, etc., on termination of lease.*—Upon termination of this lease, by surrender or forfeiture, the lessee shall have the privilege at any time within a period of 90 days thereafter of removing from the premises all machinery, equipment, tools and materials, other than underground timbering placed by the lessee in or on the leased lands, which are not necessary for the preservation of the mine. Any materials, tools, appliances, machinery, structures, and equipment, subject to removal as above provided, which are allowed to remain on the leased lands shall become the property of the lessor on expiration of the 90-day period or such extension thereof as may be granted because of adverse climatic conditions, but the lessee shall remove any or all of such property where so directed by the lessor.

SEC. 8. *Proceedings in case of default.*—If the lessee shall not comply with any of the provisions of the act or the regulations thereunder or default in the performance or observance of any of the provisions of this lease, and such default shall continue for a period of 30 days after service of written notice thereof by the lessor, the lessor may institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this lease as provided in section 31 of the act (30 U. S. C., sec. 188). If the lessee fails to take prompt and necessary steps to prevent loss or damage to the mine, property, or premises, or danger to the employees, the lessor may enter on the premises and take such measures as may be deemed necessary to prevent such loss or damage or to correct the dangerous or unsafe condition of the mine or works thereof, which shall be at the expense of the lessee. However, the lessee shall not be held responsible for delays or casualties occasioned by causes beyond the lessee's control.

SEC. 9. *Heirs and successors in interest.*—Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

SEC. 10. *Unlawful interest.*—No Member of, or Delegate to Congress, or Resident Commissioner, after his election or appointment, or either before or after he has qualified, and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, shall be admitted to any share or part of this lease, or derive any benefit that may arise therefrom, and the provisions of Rev. Stat., sec. 3741, as amended (41 U. S. C., sec. 22), and 18 U. S. C., secs. 431, 432, and 433, relating to contracts, enter into and form a part of this lease so far as the same may be applicable.

IN WITNESS WHEREOF:

THE UNITED STATES OF AMERICA,

Acting By

William R. Rives
Director of the Bureau of Land Management.

(Witnesses to signature of lessee)

(If this

is executed by a corporation, it must bear the c

seal)

NOTE.—The reporting requirement o

has been approved by the Bureau of the Budget

in accordance with the Federal Reports Act of

1942.

U. S. GOVERNMENT PRINTING OFFICE 16-64208-1

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FOR USGS

Land Office
1245 North 29th Street
Billings, Montana

Serial Number
MONTANA 057934

COAL LEASE
Act of February 25, 1920 (41 Stat. 437), as amended

This lease, entered into on October 1, 1963, by the United States of America, the lessor, through the Bureau of Land Management, and Rosebud Coal Sales Company
P. O. Box 724
Sheridan, Wyoming

the lessee, pursuant and subject to the terms and provisions of the act of February 25, 1920 (41 Stat. 437), as amended, hereinafter referred to as the act, and to all reasonable regulations of the Secretary of the Interior now in force which are made a part hereof,

Witnesseth:

Section 1. *Rights of lessee.* The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all the coal in the following-described tracts of land, Section 10, T 9 S, R 40 E, Mont. Prin Mer
of Montana.

Sec 3: Lots 3, 4, S 1/2 NW 1/4, SW 1/4
Sec 4: Lots 1, 2, S 1/2 NW 1/4, SE 1/4
Sec 9: E 1/4
Sec 10: All
Sec 15: W 1/4
Sec 21: E 1/4
Sec 22: W 1/4

SEP 27 '63 QFC
RECEIVED
BILLINGS, MONTANA

Big Horn County, Montana

containing 2,560.55 acres, more or less, together with the right to construct all such works, buildings, plants, structures, and appliances as may be necessary and convenient for the mining and preparation of the coal for market, the manufacture of coke or other products of coal, the housing and welfare of employees, and, subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted.

Sec. 2. In consideration of the foregoing, the lessee hereby agrees:

(a) *Bond.* To maintain the bond furnished upon the issuance of this lease, which bond is conditioned upon compliance with all the provisions of the lease, and to increase the amount or furnish such other bond as may be required.

(b) *Rental.* To pay the lessor annually, in advance, for each acre or part thereof covered by this lease, beginning with the date hereof, the following rentals: 25 cents for the first year, 50 cents for the second, third, fourth, and fifth years, respectively, and \$1 for the sixth and each succeeding year during the continuance of the lease, such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid.

(c) *Royalty.* To pay the lessor a royalty of 10 cents a ton of 2,000 pounds for coal mined during the first 5 years of the lease; 12½ cents a ton for coal mined during the next 5 years of the lease, and 15 cents a ton for coal mined during the remainder of the first 20-year period of the lease. Royalties shall be payable quarterly, within 30 days from the expiration of the quarter in which the coal is mined.

the lessee shall pay a royalty, less rent, on each minimum amount of the leased deposits, for one year in advance, in which case operations may be suspended for that year.

(e) *Payments.* To make rental payments to the Manager of the appropriate Land Office, except that when this lease becomes productive the rentals and royalties shall be paid to the appropriate Regional Mining Supervisor of the United States Geological Survey, with whom all reports concerning operations under the lease shall be filed. All remittances to the Manager of the Land Office shall be made payable to the Bureau of Land Management, those to the Geological Survey shall be made payable to the United States Geological Survey.

(f) *Plats, reports, maps.* At such times and in such form as the lessor may prescribe, to furnish a plat showing development work and improvements on the leased lands and a report with respect to stockholders, investment, depreciation, and costs. To furnish in such form as the lessor may prescribe, within 30 days from the expiration of each quarter a report covering such quarter, certified by the superintendent of the mine, or by such other agent having personal knowledge of the facts as may be designated by the lessee for such purpose, showing the amount of leased deposits mined during the quarter, the character and quality thereof; amount of its products and byproducts disposed of and price received therefor, and amount in storage or held for sale. To keep and prepare maps of the leased lands in accordance with the regulations in 30 CFR, part 211.

(g) *Weights.* To determine accurately the weight or quantity and quality of all leased deposits mined, and to enter

accurately the weight or quantity and quality thereof in due form in books to be kept and preserved by the lessee for such purposes.

(h) *Inspection.* To permit at all reasonable times (1) inspection by any duly authorized officer of the Department, of the leased premises and all surface and underground improvements, works, machinery, equipment, and all books and records pertaining to operations and surveys or investigations under this lease; and (2) the lessor to make copies of and extracts from any or all books and records pertaining to operations under this lease, if desired.

(i) *Assignment.* To file for approval in the appropriate Land Office within 90 days from the date of execution, any assignment or transfer made of this lease, whether by direct assignment, operating agreement, working or royalty interest, or otherwise. Such instrument will take effect the first day of the month following its approval by the Bureau of Land Management, or if the assignee requests, the first day of the month of approval. The showing required to be made with an assignment or transfer is set forth in the regulations, 43 CFR 193.25.

(j) *Nondiscrimination.* In connection with the performance of work under this lease, the lessee agrees not to discriminate against any employee or applicant for employment because of race, religion, color, or national origin. The aforesaid provision shall include, but not be limited to, the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The lessee also agrees to post hereafter in conspicuous places, available for employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of the nondiscrimination clause. The lessee further agrees to insert the foregoing provision in all subcontracts hereunder, except subcontracts for standard commercial supplies or raw materials.

(k) *Land disposed of with coal deposits reserved to the United States.* If the lands embraced herein have been or shall hereafter be disposed of under laws reserving to the United States the deposits of coal therein, to comply with all conditions as are or may hereafter be provided by the laws and regulations reserving such coal.

(l) *Operations, wages, freedom of purchase.* To comply with the operating regulations (30 CFR, part 211), to exercise reasonable diligence, skill, and care in the operations of the property, and to carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health or property, and of waste or damage to any water or mineral deposits; to fairly and justly weigh or measure the coal mined by each miner, to pay all wages due miners and employees, both above and below ground, at least twice each month in lawful money of the United States; to accord all miners and employees complete freedom of purchase; to restrict the workday to not exceeding eight hours in any one day for underground workers, except in cases of emergency; to employ no boy under the age of sixteen and no girl or woman,

without regard to age, in any mine, the surface; unless the laws of the State otherwise provide, in which case the State laws control.

(m) *Taxes.* To pay when due, all taxes lawfully assessed and levied under the laws of the State or the United States upon improvements, output of mines, or other rights, property, or assets of the lessee.

(n) *Overriding royalties.* Not to create, by assignment or otherwise, an overriding royalty interest in excess of 50 percent of the rate of royalty first payable to the United States under this lease or an overriding royalty interest which when added to any other outstanding overriding royalty interest exceeds that percentage, excepting, that where an interest in the leasehold or in an operating agreement is assigned, the assignor may retain an overriding royalty interest in excess of the above limitation if he shows to the satisfaction of the Bureau of Land Management, that he has made substantial investments for improvements on the land covered by the assignment.

(o) *Delivery of premises in case of forfeiture.* In case of forfeiture of this lease, to deliver up to the lessor in good order and condition the land leased, including all buildings, and underground timbering and such other supports and structures as are necessary for the preservation of the mine or deposit.

Sec. 3. The lessor expressly reserves:

(a) *Rights reserved.* The right to permit for joint or several use such easements or rights-of-way, including easements in tunnels upon, through, or in the land leased, occupied, or used as may be necessary or appropriate to the working of the same or other lands containing the deposits described in the act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

(b) *Disposition of surface.* The right to lease, sell, or otherwise dispose of the surface of the leased lands under existing law or laws hereafter enacted, insofar as said surface is not necessary for the use of the lessee in the extraction and removal of the coal therein, or to dispose of any resource in such lands which will not unreasonably interfere with operations under this lease.

(c) *Monopoly and fair prices.* Full power and authority to promulgate and enforce all the provisions of section 30 of the act to insure the sale of the production of said leased lands to the United States and to the public at reasonable prices, to prevent monopoly, and to safeguard the public welfare.

(d) *Readjustment of terms.* The right reasonably to readjust and fix royalties payable hereunder and other terms and conditions at the end of 20 years from the date hereof and thereafter at the end of each succeeding 20-year period during the continuance of this lease unless otherwise provided by law at the time of the expiration of any such period. Unless the lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for a 20-year period, he will be deemed to have agreed to such terms.

(e) *Waiver of conditions.* The right to waive any breach of the conditions contained herein, except the breach of such conditions as are required by the act, but any such waiver shall extend only to the particular breach so waived and shall not limit the rights of the lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this lease for any other cause, or for the same cause occurring at another time.

Sec. 4. Relinquishment of lease. Upon a satisfactory showing that the public interest will not be impaired, the lessee may surrender the entire lease or any legal subdivision thereof. A relinquishment must be filed in duplicate in the appropriate Land Office. Upon its acceptance it shall be effective as of the date it is filed, subject to the continued obligation of the lessee and his surety to make payment of all accrued rentals and royalties and to provide for the preservation of any mines or productive works or permanent improve-

ments on the land in accordance with the regulations and terms of the lease.

Sec. 5. Protection of the surface, natural resources, and improvements. The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) Causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the United States or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the surface of the leased land to its former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the United States and improvements thereon.

Sec. 6. Removal of equipment, etc., on termination of lease. Upon termination of this lease, by surrender or forfeiture, the lessee shall have the privilege at any time within a period of 90 days thereafter of removing from the premises all machinery, equipment, tools and materials, other than underground timbering placed by the lessee in or on the leased lands, which are not necessary for the preservation of the mine. Any materials, tools, appliances, machinery, structures, and equipment, subject to removal as above provided, which are allowed to remain on the leased lands shall become the property of the lessor on expiration of the 90-day period or such extension thereof as may be granted because of adverse climatic conditions, but the lessee shall remove any or all of such property where so directed by the lessor.

Sec. 7. Proceedings in case of default. If the lessee shall not comply with any of the provisions of the act or the regulations thereunder or default in the performance or observance of any of the provisions of this lease, and such default shall continue for a period of 30 days after service of written notice thereof by the lessor, the lessor may institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this lease as provided in section 31 of the act (30 USC, sec. 188). If the lessee fails to take prompt and necessary steps to prevent loss or damage to the mine, property, or premises, or danger to the employees, the lessor may enter on the premises and take such measures as may be deemed necessary to prevent such loss or damage or to correct the dangerous or unsafe condition of the mine or works thereof, which shall be at the expense of the lessee. However, the lessee shall not be held responsible for delays or casualties occasioned by causes beyond the lessee's control.

Sec. 8. Heirs and successors in interest. Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 9. Unlawful interest. No Member of, or Delegate to, Congress or Resident Commissioner, after his election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as provided in 43 CFR 7.4(a)(1), shall be admitted to any share or part in this lease or derive any benefit that may arise therefrom, and the provisions of section 3741 of the Revised Statutes of the United States, as amended (41 USC, sec. 22), and sections 431, 432, and 433, title 18, U. S. Code, relating to contracts, enter into and form a part of this lease so far as the same may be applicable.

IN WITNESS WHEREOF:

THE UNITED STATES OF AMERICA

By Helen R. Jamison
(Signing Officer)
Helen R. Jamison
Acting Chief, Minerals Section
(Title) (Date)

WITNESSES TO SIGNATURE OF LESSEE

Rosebud Coal Sales Company
(Signature of Lessee)

TEST: R. J. Daniels
Royalty Clerk, BLM, Rosebud, Montana

By: T. F. Armstrong
(Signature of Lessee)

T. F. Armstrong, President & Treas.
(Signature of Lessee)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Billings
Land Office
1245 North 29th Street
Billings, Montana

COAL LEASE

Act of February 25, 1920 (41 Stat. 437), as amended

Serial Number
MONTANA 057934

U.S. GEOLOGICAL SURVEY

This lease, entered into on October 1, 1963, by the United States of America, the lessor, through the Bureau of Land Management, and Rosebud Coal Sales Company
P. O. Box 724
Sheridan, Wyoming

the lessee, pursuant and subject to the terms and provisions of the act of February 25, 1920 (41 Stat. 437), as amended, hereinafter referred to as the act, and to all reasonable regulations of the Secretary of the Interior now in force which are made a part hereof,

Witnesseth:

SEP 23-63 2 00 377 19**272355

Section 1. *Rights of lessee.* The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all the coal in the following-described tracts of land, situated in the State of Montana.

T 9 S., R 40 E., Mont. Prin Mer
Sec. 3, Lots 3 & 4 SW 1/4

Description of land assigned to DECKER COAL COMPANY effective October 1, 1971, serial number MONTANA 057934-A:

T. 9 S., R. 40 E., P.M., Montana

- Sec. 3, Lots 3 and 4
- Sec. 4, Lots 1 and 2
- Sec. 9, SW 1/4, SE 1/4
- Sec. 10, SW 1/4, SE 1/4
- Sec. 15, W 1/2
- Sec. 21, E 1/2
- Sec. 22, W 1/2

Containing 1840.55 acres

The "A" lease retains the original issuance date, October 1, 1963, and the terms and conditions.

Description of land remaining in original lease MONTANA 057934:

T. 9 S., R. 40 E., P.M., Montana

- Sec. 3, SW 1/4, SW 1/4
- Sec. 4, SW 1/4, SE 1/4
- Sec. 9, NW 1/4
- Sec. 10, NW 1/2

Containing 720.00 acres

(c) *Royalty.* To pay the lessor a royalty of 10 cents a ton of 2,000 pounds for coal mined during the first 5 years of the lease; 12½ cents a ton for coal mined during the next 5 years of the lease, and 15 cents a ton for coal mined during the remainder of the first 20-year period of the lease. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

lessee shall pay a royalty, less rent, on such minimum amount of the leased deposits, for one year in advance, in which case operations may be suspended for that year.

(e) *Payments.* To make rental payments to the Manager of the appropriate Land Office, except that when this lease becomes productive the rentals and royalties shall be paid to the appropriate Regional Mining Supervisor of the United States Geological Survey, with whom all reports concerning operations under the lease shall be filed. All remittances to the Manager of the Land Office shall be made payable to the Bureau of Land Management, those to the Geological Survey shall be made payable to the United States Geological Survey.

(f) *Plats, reports, maps.* At such times and in such form as the lessor may prescribe, to furnish a plat showing development work and improvements on the leased lands and a report with respect to stockholders, investment, depreciation, and costs. To furnish in such form as the lessor may prescribe, within 30 days from the expiration of each quarter a report covering such quarter, certified by the superintendent of the mine, or by such other agent having personal knowledge of the facts as may be designated by the lessee for such purpose, showing the amount of leased deposits mined during the quarter, the character and quality thereof, amount of its products and byproducts disposed of and price received therefor, and amount in storage or held for sale. To keep and prepare maps of the leased lands in accordance with the regulations in 30 CFR, part 211.

(g) *Weights.* To determine accurately the weight or quantity and quality of all leased deposits mined, and to enter

or otherwise. Such instrument will take effect the first day of the month following its approval by the Bureau of Land Management, or if the assignee requests, the first day of the month of approval. The showing required to be made with an assignment or transfer is set forth in the regulations, 43 CFR 193.25.

(i) *Nondiscrimination.* In connection with the performance of work under this lease, the lessee agrees not to discriminate against any employee or applicant for employment because of race, religion, color, or national origin. The aforesaid provision shall include, but not be limited to, the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The lessee also agrees to post hereafter in conspicuous places, available for employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of the nondiscrimination clause. The lessee further agrees to insert the foregoing provision in all subcontracts hereunder, except subcontracts for standard commercial supplies or raw materials.

(k) *Land disposed of with coal deposits reserved to the United States.* If the lands embraced herein have been or shall hereafter be disposed of under laws reserving to the United States the deposits of coal therein, to comply with all conditions as are or may hereafter be provided by the laws and regulations reserving such coal.

(l) *Operations, wages, freedom of purchase.* To comply with the operating regulations (30 CFR, part 211), to exercise reasonable diligence, skill, and care in the operations of the property, and to carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health or property, and of waste or damage to any water or mineral deposits; to fairly and justly weigh or measure the coal mined by each miner, to pay all wages due miners and employees, both above and below ground, at least twice each month in lawful money of the United States, to accord all miners and employees complete freedom of purchase; to restrict the workday to not exceeding eight hours in any one day for underground workers, except in case of emergency; to employ no boy under the age of sixteen and no girl or woman,

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
1245 North 29th Street
Billings, Montana, 59101
COAL LEASE

Land Office

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
1245 North 29th Street
Billings, Montana 59101

Serial Number

Act of February 25, 1920 (41 Stat. 437), as amended 1964 FEB 3 AM 10 00 MONTANA 061685

This lease, entered into on March 1, 1964, by the United States of America, the lessor, through the Bureau of Land Management, and

Rosebud Coal Sales Company
P. O. Box 724
Sheridan, Wyoming

RECEIVED
MONTANA LAND OFFICE
BILLINGS, MONTANA
U. S. GEOLOGICAL SURVEY
Pasted to book, plotted
Sheet, Card made
FEB 11 '64 Jm

the lessee, pursuant and subject to the terms and provisions of the Act of February 25, 1920 (41 Stat. 437), as amended, hereinafter referred to as the Act, and to all reasonable regulations of the Secretary of the Interior now in force which are made a part hereof,

WITNESSETH:

Sec. 1. *Rights of lessee.* The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all the coal in the following-described tracts of land, situated in the State of **Montana**

T 8 S, R 40 E, Mont. Prin Mer

Sec 32: NE $\frac{1}{4}$, SE $\frac{1}{4}$

Sec 33: W $\frac{1}{2}$ NW $\frac{1}{4}$, NE $\frac{1}{2}$ NW $\frac{1}{4}$, NW $\frac{1}{2}$ SW $\frac{1}{4}$, S $\frac{1}{2}$ SW $\frac{1}{4}$, E $\frac{1}{2}$

T 9 S, R 40 E, Mont. Prin Mer

Sec 4: Lot 3, SE $\frac{1}{4}$ NW $\frac{1}{4}$, SW $\frac{1}{4}$

Sec 9: E $\frac{1}{2}$ NW $\frac{1}{4}$, SW $\frac{1}{4}$

Sec 17: NE $\frac{1}{4}$, SE $\frac{1}{4}$

Sec 21: W $\frac{1}{2}$

Big Horn County

containing **2,320.20** acres, more or less, together with the right to construct all such works, buildings, plants, structures, and appliances as may be necessary and convenient for the mining and preparation of the coal for market, the manufacture of coke or other products of coal, the housing and welfare of employees, and subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted.

Sec. 2. In consideration of the foregoing, the lessee hereby agrees:

(a) *Bond.* To maintain the bond furnished upon the issuance of this lease, which bond is conditioned upon compliance with all the provisions of the lease, and to increase the amount or furnish such other bond as may be required.

(b) *Rental.* To pay the lessor annually, in advance, for each acre or part thereof covered by this lease, beginning with the date hereof, the following rentals: 25 cents for the first year, 50 cents for the second, third, fourth, and fifth years, respectively, and \$1 for the sixth and each succeeding year during the continuance of the lease, such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid.

(c) *Royalty.* To pay the lessor a royalty of _____ cents per ton of coal mined, less rent, on such minimum amount

(c) *Royalty.* A royalty of 10 cents per ton of 2,000 pounds for coal mined during the first 5 years of the lease 12 $\frac{1}{2}$ cents a ton for coal mined during the next 5 years of the lease, and 15 cents a ton for coal mined during the remainder of the first 20-year period of the lease. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

See attached sheet

(e) *Payments.* To make rental payments to the Manager of the appropriate Land Office, except that when this lease becomes productive the rentals and royalties shall be paid to the appropriate Regional Mining Supervisor of the United States Geological Survey, with whom all reports concerning operations under the lease shall be filed. All remittances to the Manager of the Land Office shall be made payable to the Bureau of Land Management, those to the Geological Survey shall be made payable to the United States Geological Survey.

(f) *Plats, reports, maps.* At such times and in such form as the lessor may prescribe, to furnish a plat showing development work and improvements on the leased lands and a report with respect to stockholders, investment, depreciation, and costs. To furnish in such form as the lessor may prescribe, within 30 days from the expiration of each quarter a report covering such quarter, certified by the superintendent of the mine, or by such other agent having personal knowledge of the facts as may be designated by the lessee for such purpose, showing the amount of leased deposits mined during the quarter, the character and quality thereof, amount of its products and byproducts disposed of and price received therefor, and amount in storage or held for sale. To keep and prepare maps of the leased lands in accordance with the regulations in 30 CFR, Part 211.

(g) *Weights.* To determine accurately the weight or quantity and quality of all leased deposits mined, and to enter accurately the weight or quantity and quality thereof in due form in books to be kept and preserved by the lessee for such purposes.

(h) *Inspection.* To permit at all reasonable times (1) inspection by any duly authorized officer of the Department, of the leased premises and all surface and underground improvements, works, machinery, equipment, and all books and records pertaining to operations and surveys or investigations under this lease; and (2) the lessor to make copies of and extracts from any or all books and records pertaining to operations under this lease, if desired.

(i) *Assignment.* To file for approval in the appropriate Land Office within 90 days from the date of execution, any assignment or transfer made of this lease, whether by direct assignment, operating agreement, working or royalty interest, or otherwise. Such instrument will take effect the first day of the month following its approval by the Bureau of Land Management, or if the assignee requests, the first day of the month of approval. The showing required to be made with an assignment or transfer is set forth in the regulations, 43 CFR 193.25.

(j) *Nondiscrimination clauses.* In connection with the performance of work under this contract, the lessee agrees as follows:

(1) The lessee will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The lessee will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The lessee agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

(2) The lessee will, in all solicitations or advertisements for employees placed by or on behalf of the lessee, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

(3) The lessee will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer,

advising the said labor union or workers' representative of the lessee's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The lessee will comply with all provisions of Executive Order No. 10925 of March 6, 1961, and of the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity created thereby.

(5) The lessee will furnish all information and reports required by Executive Order No. 10925 of March 6, 1961, and by the rules, regulations, and orders of the said Committee, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Committee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the lessee's noncompliance with the nondiscrimination clause of this contract or with any of the said rules, regulations, or orders, this lease may be canceled in whole or in part and the lessee may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 10925 of March 6, 1961, and such other sanctions may be imposed and remedies invoked as provided in the said Executive Order or by rule, regulation, or order of the President's Committee on Equal Employment Opportunity, or as otherwise provided by law.

(7) The lessee will include the provisions of the foregoing paragraphs (1) through (6) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the President's Committee on Equal Employment Opportunity issued pursuant to Section 303 of Executive Order No. 10925 of March 6, 1961, so that such provisions will be binding upon each subcontractor or vendor. The lessee will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided, however,* that in the event the lessee becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the lessee may request the United States to enter into such litigation to protect the interests of the United States.

NOTE TO CONTRACTOR - (Additional requirement for subcontracts with the Department of the Interior) - In compliance with the Rules and Regulations (41 CFR, Section 60-1.3(a)) issued under Executive Order 10925 of March 6, 1961, the prime contractor is hereby bound and agrees to include in each subcontract which it shall make with a subcontractor or supplier paragraphs (1) through (7) of Section 301 of said Executive Order (as quoted above), unless exempted pursuant to the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity.

(k) *Land disposed of with coal deposits reserved to the United States.* If the lands embraced herein have been or shall hereafter be disposed of under laws reserving to the United States the deposits of coal therein, to comply with all conditions as are or may hereafter be provided by the laws and regulations reserving such coal.

(l) *Operations, wages, freedom of purchase.* To comply with the operating regulations (30 CFR, Part 211), to exercise reasonable diligence, skill, and care in the operations of the property, and to carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health or property, and of waste or damage to any water or mineral deposits; to fairly and justly weigh or measure the coal mined by each miner, to pay all wages due miners and employees, both above and below ground, at least twice each month in lawful money of the United States; to accord all miners and employees complete freedom of purchase; to restrict the workday to not exceeding eight hours in any one day for underground workers, except in cases of emergency; to employ no boy under the age of sixteen and no girl or woman,

without regard to age, in any mine below the surface; unless the laws of the State otherwise provide, in which case the State laws control.

(m) *Taxes.* To pay when due, all taxes lawfully assessed or levied under the laws of the State or the United States upon improvements, output of mines, or other rights, property, or assets of the lessee.

(n) *Overriding royalties.* Not to create, by assignment or otherwise, an overriding royalty interest in excess of 50 percent of the rate of royalty first payable to the United States under this lease or an overriding royalty interest which when added to any other outstanding overriding royalty interest exceeds that percentage, excepting, that where an interest in the leasehold or in an operating agreement is assigned, the assignor may retain an overriding royalty interest in excess of the above limitation if he shows to the satisfaction of the Bureau of Land Management, that he has made substantial investments for improvements on the land covered by the assignment.

(o) *Delivery of premises in case of forfeiture.* In case of forfeiture of this lease, to deliver up to the lessor in good order and condition the land leased, including all buildings, and underground timbering and such other supports and structures as are necessary for the preservation of the mine or deposit.

Sec. 3. The lessor expressly reserves:

(a) *Rights reserved.* The right to permit for joint or several use such easements or rights-of-way, including easements in tunnels upon, through, or in the land leased, occupied, or used as may be necessary or appropriate to the working of the same or other lands containing the deposits described in the Act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

(b) *Disposition of surface.* The right to lease, sell, or otherwise dispose of the surface of the leased lands under existing law or laws hereafter enacted, insofar as said surface is not necessary for the use of the lessee in the extraction and removal of the coal therein, or to dispose of any resource in such lands which will not unreasonably interfere with operations under this lease.

(c) *Monopoly and fair prices.* Full power and authority to promulgate and enforce all the provisions of Section 30 of the Act to insure the sale of the production of said leased lands to the United States and to the public at reasonable prices, to prevent monopoly, and to safeguard the public welfare.

(d) *Readjustment of terms.* The right reasonably to readjust and fix royalties payable hereunder and other terms and conditions at the end of 20 years from the date hereof and thereafter at the end of each succeeding 20-year period during the continuance of this lease unless otherwise provided by law at the time of the expiration of any such period. Unless the lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for a 20-year period, he will be deemed to have agreed to such terms.

(e) *Waiver of conditions.* The right to waive any breach of the conditions contained herein, except the breach of such conditions as are required by the Act, but any such waiver shall extend only to the particular breach so waived and shall not limit the rights of the lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this lease for any other cause, or for the same cause occurring at another time.

Sec. 4. Relinquishment of lease. Upon a satisfactory showing that the public interest will not be impaired, the lessee may surrender the entire lease or any legal subdivision thereof. A relinquishment must be filed in duplicate in the appropriate Land Office. Upon its acceptance it shall be effective as of the date it is filed, subject to the continued obligation of the lessee and his surety to make payment of all accrued rentals and royalties and to provide for the preservation of any mines or productive works or permanent improve-

ments on the leased lands in accordance with the regulations and terms of the lease.

Sec. 5. Protection of the surface, natural resources, and improvements. The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) Causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the United States or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the surface of the leased land to its former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the United States and improvements thereon.

Sec. 6. Removal of equipment, etc., on termination of lease. Upon termination of this lease, by surrender or forfeiture, the lessee shall have the privilege at any time within a period of 90 days thereafter of removing from the premises all machinery, equipment, tools and materials, except underground timbering placed by the lessee in or on the leased lands, which are necessary for the preservation of the mine. Any materials, tools, appliances, machinery, structures, and equipment, subject to removal as above provided, which are allowed to remain on the leased lands shall become the property of the lessor on expiration of the 90-day period or such extension thereof as may be granted because of adverse climatic conditions, but the lessee shall remove any or all of such property where so directed by the lessor.

Sec. 7. Proceedings in case of default. If the lessee shall not comply with any of the provisions of the Act or the regulations thereunder or default in the performance or observance of any of the provisions of this lease, and such default shall continue for a period of 30 days after service of written notice thereof by the lessor, the lessor may institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this lease as provided in Section 31 of the Act (30 USC, Sec. 188). If the lessee fails to take prompt and necessary steps to prevent loss of damage to the mine, property, or premises, or danger to the employees, the lessor may enter on the premises and take such measures as may be deemed necessary to prevent such loss or damage or to correct the dangerous or unsafe condition of the mine or works thereof, which shall be at the expense of the lessee. However, the lessee shall not be held responsible for delays or casualties occasioned by causes beyond the lessee's control.

Sec. 8. Heirs and successors in interest. Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 9. Unlawful interest. No Member of, or Delegate to, Congress, or Resident Commissioner, after his election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as provided in 43 CFR 7.4(a)(1), shall be admitted to any share or part in this lease or derive any benefit that may arise therefrom; and the provisions of Section 3741 of the Revised Statutes of the United States, as amended (41 USC, Sec. 22), and Sections 431, 432, and 433, Title 18, U. S. C., relating to contracts, enter into and form a part of this lease so far as the same may be applicable.

IN WITNESS WHEREOF:

THE UNITED STATES OF AMERICA

By (Signed) BETTY B. BALTRUSCH
(Signing Officer)

Chief, Minerals Section
(Title)

FEB 5 1964
(Date)

WITNESSES TO SIGNATURE OF LESSEE

ROSEBUD COAL SALES CO.
(Signature of Lessee)


Ass't. Secretary


(Signature of Lessee)
Vice President

(Signature of Lessee)

(If this lease is executed by a corporation, it must bear the corporate seal)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Land Office
316 North 26th Street
Billings, Montana 59101

*Plotted
Partially to hook interest.
Carroll, Plot 1, 2, 3, 4
MONTANA 061685*
U. S. GEOLOGICAL SURVEY

MODIFIED COAL LEASE UNDER SECTION 3
Act of February 25, 1920 (41 Stat. 437), as amended

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RECEIVED SAM

This lease, entered into on November 1, 1966, by the United States of America, the lessor, through the Bureau of Land Management, and the Pacific Power & Light Company, the lessee.

WITNESSETH:

THAT, WHEREAS, the lessee is now the holder of coal lease MONTANA 061685, issued effective March 1, 1964 under the Act of February 25, 1920 (41 Stat. 437), as amended, which lease embraces 2,320.20 acres in Big Horn County, Montana.

AND WHEREAS, upon application by the lessee for modification of the lease, it has been found that it will be to the advantage of the lessee and the United States to modify the lease under Section 3 of the Act cited, to include additional lands described as follows, containing 40.00 acres:

T 9 S, R 40 E, P.M., Montana
Sec. 8: SE $\frac{1}{2}$ SE $\frac{1}{2}$

NOW, THEREFORE, the lessor in consideration of the rents and royalties to be paid and the covenants to be observed as set out in said lease, does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all coal under, upon, or in the above described lands, subject to the following conditions:

- (a) That the rental on the additional lands shall be 25 cents for each acre or fraction thereof for the period from date hereof to the next anniversary of the original lease and thereafter the rate provided for the lands embraced in the original lease.
- (b) ~~That the minimum production on the leased lands shall be \$1.00 effective the first full lease month following date hereof.~~ See memo 11/23/66
- (c) A royalty of 17 $\frac{1}{2}$ cents per ton of 2,000 pounds for coal mined to March 1, 1974, and 20 cents a ton for coal mined during the remainder of the first 20-year period of the lease.
- (d) That all of the other terms and conditions of the original lease in effect on date hereof shall be unaffected hereby and shall be applicable to the lease as modified herein.

The lease, as modified herein, embraces the following described lands:

T 8 S, R 40 E, P.M., Montana

Sec. 32: N $\frac{1}{2}$, SE $\frac{1}{2}$

Sec. 33: W $\frac{1}{2}$ NW $\frac{1}{2}$, NE $\frac{1}{2}$ NW $\frac{1}{2}$, NW $\frac{1}{2}$ SW $\frac{1}{2}$, S $\frac{1}{2}$ SW $\frac{1}{2}$, E $\frac{1}{2}$

T 9 S, R 40 E, P.M., Montana

Sec. 4: Lot 3, SE $\frac{1}{2}$ NW $\frac{1}{2}$, SW $\frac{1}{2}$

Sec. 8: SE $\frac{1}{2}$ SE $\frac{1}{2}$

Sec. 9: E $\frac{1}{2}$ NW $\frac{1}{2}$, SW $\frac{1}{2}$

Sec. 17: N $\frac{1}{2}$, SE $\frac{1}{2}$

Sec. 21: W $\frac{1}{2}$

Containing 2,360.20 acres

IN WITNESS WHEREOF:

THE UNITED STATES OF AMERICA

By: (Signed) Betty B. Baltrusch

Lessor

Betty B. Baltrusch, Chief
Minerals Adjudication Section

PACIFIC POWER & LIGHT COMPANY

By:

E. A. DeSuccia
VICE PRESIDENT

Lessee

(SEAL)

Thomas R. Kuylen
(Witness to signature of Lessee)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

COAL LEASE

Land Office
316 North 26th Street
Billings, Montana 59101

Serial Number
MONTANA 073093

This lease, entered into on the 1st day of August, 1966, by the United States of America, the lessor,

through the Bureau of Land Management, and
*Posted to book, with sheet
care made at Billings, planned*
U. S. GEOLOGICAL SURVEY

Peter Kiewit Sons' Co.
P. O. Box 724
Sheridan, Wyoming 82801

JUL 22 '66

RECEIVED
BILLINGS MONTANA

, the lessee,
pursuant and subject to the terms and provisions of the Act of February 25, 1920 (41 Stat. 437), as amended, herein-
after referred to as the Act, and to all reasonable regulations of the Secretary of the Interior now or hereafter in force
which are made a part hereof,

WITNESSETH:

Sec. 1. *Rights of Lessee.* The lessor, in consideration of the rents and royalties to be paid and the conditions to be
observed as hereinafter set forth does hereby grant and lease to the lessee the exclusive right and privilege to mine
and dispose of all the coal in the following-described tracts of land, situated in the State of Montana

T 9 S, R 40 E, P.M., Montana

Sec 1: Lots 1, 3, 4, SE $\frac{1}{4}$ NE $\frac{1}{4}$,
SW $\frac{1}{4}$, SW $\frac{1}{4}$, E $\frac{1}{2}$ SE $\frac{1}{4}$

Sec 13: All

Sec 14: SE $\frac{1}{4}$ NE $\frac{1}{4}$, E $\frac{1}{2}$ SW $\frac{1}{4}$, SE $\frac{1}{4}$

T 8 S, R 41 E, P.M., Montana

Sec 31: Lots 3, 4, E $\frac{1}{2}$ SW $\frac{1}{4}$, SE $\frac{1}{4}$

Sec 32: SE $\frac{1}{4}$

Sec 33: SE $\frac{1}{4}$

Sec 34: SW $\frac{1}{4}$, W $\frac{1}{2}$ SE $\frac{1}{4}$

T 9 S, R 41 E, P.M., Montana

Sec 3: Lots 5, 6, 7, 8, SE $\frac{1}{4}$, SE $\frac{1}{4}$ 16

Sec 4: Lots 5, 6, 7, 8, SE $\frac{1}{4}$, SE $\frac{1}{4}$ 16

Sec 5: Lots 5, 6, 7, 8, SE $\frac{1}{4}$, SE $\frac{1}{4}$ 16

Sec 6: Lots 6, 7, 8, 9, 10, 11, 12,
SE $\frac{1}{4}$ NE $\frac{1}{4}$, SE $\frac{1}{4}$ SW $\frac{1}{4}$, E $\frac{1}{2}$ SW $\frac{1}{4}$, SE $\frac{1}{4}$ 16

Sec 7: Lots 5, 6, 7, 8, E $\frac{1}{2}$, E $\frac{1}{2}$ SW $\frac{1}{4}$ 16

Sec 8: All

Sec 9: NE $\frac{1}{4}$, SW $\frac{1}{4}$, NE $\frac{1}{4}$ SE $\frac{1}{4}$, SW $\frac{1}{4}$ SE $\frac{1}{4}$ 15

Sec 10: NE $\frac{1}{4}$, NE $\frac{1}{4}$ SW $\frac{1}{4}$, SE $\frac{1}{4}$ SW $\frac{1}{4}$, SE $\frac{1}{4}$ 15

Sec 15: All

Sec 17: All

Sec 18: Lots 5, 6, 7, 8, E $\frac{1}{2}$, E $\frac{1}{2}$ SW $\frac{1}{4}$ 16

Big Horn Co.

containing 9,409.56 acres, more or less, together with the right to construct all such works, buildings, plants,
structures, and appliances as may be necessary and convenient for the mining and preparation of the coal for market,
the manufacture of coke or other products of coal, the housing and welfare of employees, and subject to the conditions
herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privi-
leges herein granted.

Sec. 2. In consideration of the foregoing, the lessee
hereby agrees:

(a) *Bond.* To maintain the bond furnished upon
the issuance of this lease, which bond is conditioned
upon compliance with all the provisions of the lease,
and to increase the amount or furnish such other bond
as may be required.

(b) *Rental.* To pay the lessor annually, in ad-
vance, for each acre or fraction thereof covered by this
lease, beginning with the date hereof, the following
rentals: 25 cents for the first year; 50 cents for the
second, third, fourth, and fifth years, respectively; and
\$1 for the sixth and each succeeding year during the
continuance of the lease, such rental for any year to be
credited against the first royalties as they accrue under
the lease during the year for which the rental was paid.

(c) *Royalty.* To pay the lessor a
royalty of 17 $\frac{1}{2}$ cents per ton of 2,000
pounds for coal mined during the first
10 years of the lease; and 20 cents a ton
for coal mined during the remainder of the
first 20-year period of the lease. Royalties
shall be payable quarterly within 30 days
from the expiration of the quarter in which
the coal is mined.

~~30 days from the expiration of the quarter in which the
coal is mined.~~

(d) *Minimum production.* Beginning with the sixth
year of the lease, *except* when operations are inter-
rupted by strikes, the elements, or casualties not
attributable to the lessee, or unless on application and
showing made, operations shall be suspended when
market conditions are such that the lessee cannot op-
erate *except* at a loss or suspended for the other
reasons specified in Section 39 of the Act, to mine coal
each year and pay a royalty thereon to a value of \$1 per
acre or fraction thereof. Operations under this lease
shall be continuous *except* in circumstances described
or unless the lessee shall pay a royalty, less rent, on
such minimum amount of the leased deposits, for one
year in advance, in which case operations may be
suspended for that year.

(e) *Payments.* To make rental payments to the
Manager of the appropriate Land Office, *except* that
when this lease becomes productive the rentals and

royalties shall be paid to the appropriate Regional Mining Supervisor of the United States Geological Survey, with whom all reports concerning operations under the lease shall be filed. All remittances to the Manager of the Land Office shall be made payable to the Bureau of Land Management, those to the Geological Survey shall be made payable to the United States Geological Survey.

(f) *Plats, reports, maps.* At such times and in such form as the lessor may prescribe, to furnish a plat showing development work and improvements on the leased lands and a report with respect to stockholders, investment, depreciation, and costs. To furnish in such form as the lessor may prescribe, within 30 days from the expiration of each quarter a report covering such quarter, certified by the superintendent of the mine, or by such other agent having personal knowledge of the facts as may be designated by the lessee for such purpose, showing the amount of leased deposits mined during the quarter, the character and quality thereof, amount of its products and byproducts disposed of and price received therefor, and amount in storage or held for sale. To keep and prepare maps of the leased lands in accordance with the appropriate regulations.

(g) *Weights.* To determine accurately the weight or quantity and quality of all leased deposits mined, and to enter accurately the weight or quantity and quality thereof in due form in books to be kept and preserved by the lessee for such purposes.

(h) *Inspection.* To permit at all reasonable times (1) inspection by any duly authorized officer of the Department, of the leased premises and all surface and underground improvements, works, machinery, equipment, and all books and records pertaining to operations and surveys or investigations under this lease; and (2) the lessor to make copies of and extracts from any or all books and records pertaining to operations under this lease, if desired.

(i) *Assignment.* To file for approval in the appropriate Land Office within 90 days from the date of execution, any assignment or transfer made of this lease, whether by direct assignment, operating agreement, working or royalty interest, or otherwise. Such instrument will take effect the first day of the month following its approval by the Bureau of Land Management, or if the assignee requests, the first day of the month of approval. The showing required to be made with an assignment or transfer is set forth in the appropriate regulations.

(j) *Nondiscrimination clauses.* During the performance of this contract the lessee agrees as follows:

(1) The lessee will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The lessee will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The lessee agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

(2) The lessee will, in all solicitations or advertisements for employees placed by or on behalf of the lessee, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

(3) The lessee will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the said labor union or workers' representative of the lessee's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The lessee will comply with all provisions of Executive Order No. 10925 of March 6, 1961, as amended, and of the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity created thereby.

(5) The lessee will furnish all information and reports required by Executive Order No. 10925 of March 6, 1961, as amended, and by the rules, regulations, and orders of the said Committee, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Committee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the lessee's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this lease may be cancelled, terminated, or suspended in whole or in part and the lessee may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 10925 of March 6, 1961, as amended, and such other sanctions may be imposed and remedies invoked as provided in the said Executive Order or by rule, regulation, or order of the President's Committee on Equal Employment Opportunity, or as otherwise provided by law.

(7) The lessee will include the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the President's Committee on Equal Employment Opportunity issued pursuant to Section 303 of Executive Order No. 10925 of March 6, 1961, as amended, so that such provisions will be binding upon each subcontractor or vendor. The lessee will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided, however,* that in the event the lessee becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the lessee may request the United States to enter into such litigation to protect the interests of the United States.

(k) *Land disposed of with coal deposits reserved to the United States.* If the lands embraced herein have been or shall hereafter be disposed of under laws reserving to the United States the deposits of coal therein, to comply with all conditions as are or may hereafter be provided by the laws and regulations reserving such coal.

(l) *Operations, wages, freedom of purchase.* To comply with the appropriate operating regulations, to exercise reasonable diligence, skill, and care in the operations of the property, and to carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health or property, and of waste or damage to any water or mineral deposits; to fairly and justly weigh or measure the coal mined by each miner, to pay all wages due miners and employees, both above and below ground, at least twice each month in lawful money of the United States; to accord all miners and employees complete freedom of purchase; to restrict the workday to not exceeding eight hours in any one day for underground

workers, except in cases of emergency; to employ no boy under the age of sixteen and no girl or woman, without regard to age, in any mine below the surface; unless the laws of the State otherwise provide, in which case the State laws control.

(m) *Taxes.* To pay when due, all taxes lawfully assessed and levied under the laws of the State or the United States upon improvements, output of mines, or other rights, property, or assets of the lessee.

(n) *Overriding royalties.* Not to create, by assignment or otherwise, an overriding royalty interest in excess of 50 percent of the rate of royalty first payable to the United States under this lease or an overriding royalty interest which when added to any other outstanding overriding royalty interest exceeds that percentage, excepting, that where an interest in the leasehold or in an operating agreement is assigned, the assignor may retain an overriding royalty interest in excess of the above limitation if he shows to the satisfaction of the Bureau of Land Management, that he has made substantial investments for improvements on the land covered by the assignment.

(o) *Delivery of premises in case of forfeiture.* In case of forfeiture of this lease, to deliver up to the lessor in good order and condition the land leased, including all buildings, and underground timbering and such other supports and structures as are necessary for the preservation of the mine or deposit.

Sec. 3. The lessor expressly reserves:

(a) *Rights reserved.* The right to permit for joint or several use such easements or rights-of-way, including easements in tunnels upon, through, or in the land leased, occupied, or used as may be necessary or appropriate to the working of the same or other lands containing the deposits described in the Act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

(b) *Disposition of surface.* The right to lease, sell, or otherwise dispose of the surface of the leased lands under existing law or laws hereafter enacted, insofar as said surface is not necessary for the use of the lessee in the extraction and removal of the coal therein, or to dispose of any resource in such lands which will not unreasonably interfere with operations under this lease.

(c) *Monopoly and fair prices.* Full power and authority to promulgate and enforce all the provisions of Section 30 of the Act to insure the sale of the production of said leased lands to the United States and to the public at reasonable prices, to prevent monopoly, and to safeguard the public welfare.

(d) *Readjustment of terms.* The right reasonably to readjust and fix royalties payable hereunder and other terms and conditions at the end of 20 years from the date hereof and thereafter at the end of each succeeding 20-year period during the continuance of this lease unless otherwise provided by law at the time of the expiration of any such period. Unless the lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for a 20-year period, he will be deemed to have agreed to such terms.

(e) *Waiver of conditions.* The right to waive any breach of the conditions contained herein, except the breach of such conditions as are required by the Act, but any such waiver shall extend only to the particular breach so waived and shall not limit the rights of the

lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this lease for any other cause, or for the same cause occurring at another time.

Sec. 4. *Relinquishment of lease.* Upon a satisfactory showing that the public interest will not be impaired, the lessee may surrender the entire lease or any legal subdivision thereof. A relinquishment must be filed in duplicate in the appropriate Land Office. Upon its acceptance it shall be effective as of the date it is filed, subject to the continued obligation of the lessee and his surety to make payment of all accrued rentals and royalties and to provide for the preservation of any mines or productive works or permanent improvements on the leased lands in accordance with the regulations and terms of the lease.

Sec. 5. *Protection of the surface, natural resources, and improvements.* The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the United States or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the surface of the leased land to its former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the United States and improvements thereon.

Sec. 6. *Removal of equipment, etc., on termination of lease.* Upon termination of this lease, by surrender or forfeiture, the lessee shall have the privilege at any time within a period of 90 days thereafter of removing from the premises all machinery, equipment, tools and materials, except underground timbering placed by the lessee in or on the leased lands, which are necessary for the preservation of the mine. Any materials, tools, appliances, machinery, structures, and equipment, subject to removal as above provided, which are allowed to remain on the leased lands shall become the property of the lessor on expiration of the 90-day period or such extension thereof as may be granted because of adverse climatic conditions, but the lessee shall remove any or all of such property where so directed by the lessor.

Sec. 7. *Proceedings in case of default.* If the lessee shall not comply with any of the provisions of the Act or the regulations thereunder or default in the performance or observance of any of the provisions of this lease, and such default shall continue for a period of 30 days after service of written notice thereof by the lessor, the lessor may institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this lease as provided in Section 31 of the Act. If the lessee fails to take prompt and necessary steps to prevent loss or damage to the mine, property, or premises, or danger to the employees, the lessor may enter on the premises and take such measures as may be deemed necessary to prevent such loss or damage or to correct the dangerous or unsafe condition of the mine or works thereof, which shall be at the expense of the lessee. However, the lessee shall

not be held responsible for delays or casualties occasioned by causes beyond the lessee's control.

Sec. 8. *Heirs and successors in interest.* Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 9. *Unlawful interest.* No Member of, or Delegate to, Congress, or Resident Commissioner, after his

election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as provided in 43 CFR 7.4(a)(1), shall be admitted to any share or part in this lease or derive any benefit that may arise therefrom; and the provisions of Section 3741 of the Revised Statutes of the United States, as amended (41 U.S.C. Sec. 22), and Sections 431, 432, and 433, Title 18, U.S.C., relating to contracts, enter into and form a part of this lease so far as the same may be applicable.

THIS LEASE WAS PREPARED BY
BETTY B. BALTRUSCH, Chief
Minerals Adjudication Section
Department of the Interior, July 24, 1966

THE UNITED STATES OF AMERICA

(Signed) Betty B. Baltrusch

By _____

(Signing Officer)

Betty B. Baltrusch, Chief

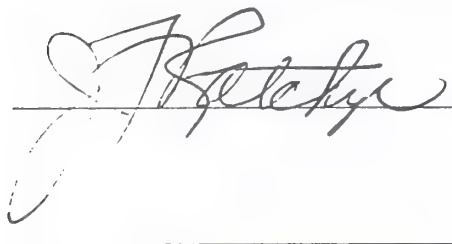
Minerals Adjudication Section

(Title)

July 19, 1966

(Date)

WITNESS TO SIGNATURE OF LESSEE



Peter Kenneth Davis Co.
(Signature of Lessee)

By Homer A. Scott V.P.

Box 917 - Shandon, Nyo.
(Signature of Lessee)

(Signature of Lessee)

(If this lease is executed by a corporation, it must bear the corporate seal)

EQUAL OPPORTUNITY

(a) Clause --, regarding "Equal Opportunity" in the Form to which this is attached, is amended by deleting references to the President's Committee on Equal Employment Opportunity, Executive Order No. 10925 of March 6, 1961, as amended, and section 303 of Executive Order No. 10925 of March 6, 1961, as amended; and substituting therefor the Secretary of Labor, Executive Order No. 11246 of September 24, 1965, and section 204 of Executive Order No. 11246 of September 24, 1965, respectively.

(b) In accordance with regulations of the Secretary of Labor, the rules, regulations, orders, instructions, designations, and other directives referred to in section 403 (b) of Executive Order No. 11246, remain in effect and, where applicable, shall be observed in the performance of this contract until revoked or superseded by appropriate authority.

(c) The Equal Employment Opportunity representation in the Form to which this is attached is amended to insert, after the reference to "Executive Order 10925" the following: "or the clause contained in section 201 of Executive Order No. 11114".

State of Montana COAL LEASE

20238

EXCHANGE

Lease No. C-527-63

This indenture of lease, made and entered into between the State of Montana, by and through its lawfully qualified and acting State Board of Land Commissioners, hereinafter referred to as lessor, and the person, company or corporation herein named, hereinafter referred to as lessee, under and pursuant to the terms and provisions of Chapter 5, Title 81, Revised Codes of Montana, 1947, and all acts amendatory thereof and supplementary thereto, WITNESSETH:

The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee, for the purpose of mining and disposing of coal and constructing all such works, buildings, plants, structures and appliances as may be necessary and convenient to produce, save, care for, dispose of and remove said coal, all the lands herein described, as follows:

Date this lease takes effect: **November 13, 1963**

Name of Lessee: **Decker Coal Company**
P. O. Box 746
Address of Lessee: **Sheridan, Wyoming 82801**

Land located in **Big Horn** county.

Description of Land: **Township 9 South, Range 40 East**
Section 16: All

Total number of acres **640**, more or less, belonging to **School** Grant.

Annual Rental, Payable each year in advance, **\$1.00 per acre for the first ten years.**
\$5.00 per acre for the eleventh through the
twentieth year. \$35,200.00 Exchange Lease Fee.

TO HAVE AND TO HOLD the said premises for a term of 20 years, together with the right, provided lessee has complied with all of the terms and conditions hereof, to lease said land for additional, successive 20-year terms. If lessee shall elect to extend this lease, lessee shall so notify lessor in writing at least 90 days prior to the expiration of the original term, or any renewal term, as the case may be. Lessor expressly reserves the right reasonably to readjust and fix royalties payable hereunder and other terms and conditions of this lease in the event lessee exercises its right to renew. Unless lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for the ensuing 20-year renewal, lessee shall be deemed to have agreed to such terms.

IT IS MUTUALLY UNDERSTOOD, AGREED AND COVENANTED BY AND BETWEEN THE PARTIES TO THIS LEASE AS FOLLOWS:

1. **RIGHTS RESERVED.** The lessor expressly reserves the right to sell, lease, or otherwise dispose of any interest or estate in the land hereby leased, except the interest conveyed by this lease, provided that the lessor hereby agrees that sales, leases or other dispositions of any interest or estate in the lands hereby leased shall be subject to the terms of this lease, and shall not interfere with the lessee's possession or rights hereunder.

2. **BOND.** The lessee shall immediately upon the execution of this lease furnish a surety bond in the amount of \$1000.00 conditioned upon compliance with the provisions of this lease or, in the option of the lessor, a cash deposit in the amount of \$1000.00.

3. **RENTAL.** The lessee shall pay the lessor annually, in advance, for each acre or fraction thereof covered by this lease, beginning with the date this lease takes effect, the following rentals: As above for the first year; As above per year for the second, third, fourth, and fifth years, respectively; and As above for the sixth and each succeeding year of this lease such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid. In no case shall the annual rental payable hereunder be less than fifty (\$50.00) dollars.

4. **ROYALTY.** The lessee shall pay the lessor a royalty on every ton of 2,000 pounds of coal mined during the term of the lease, and royalty to be at the rate of 15¢ per ton on lignite coal and 17½¢ per ton on sub-bituminous coal, type of coal to be determined when production occurs. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

5. **REPORTS.** At such times and in such form as the lessor shall prescribe, the lessee shall furnish to lessor and to the Montana state bureau of mines and geology reports, plats and maps showing exploration data, development work, improvements, amount of leased deposits mined, and any other information with respect to the land leased which the lessor may require.

6. **INSPECTION.** The lessee shall permit at all reasonable times inspection by the lessor or the Montana State bureau of mines and geology of the leased premises and all books and records pertaining to operations and surveys or investigations under this lease. The lessee shall also permit the lessor or the Montana state bureau of mines and geology to make copies of and extracts from all books and records pertaining to operations under this lease.

7. **ASSIGNMENT.** This lease may not be assigned without the prior approval of the lessor in writing.

8. TERMINATION. The lessee shall have the right at the termination of any rental year, by giving at least 30 days previous notice in writing to the Commissioner of State Lands and Investments to surrender and relinquish this lease and thereupon be discharged from any obligation not theretofore accrued. The lessor may declare this lease forfeited and cancel the same through the State Board of Land Commissioners upon failure of the lessee to fully comply with the terms of this lease, after written notice from said board and reasonable time fixed and allowed by it to the lessee to perform the undertaking or obligation specified in said notice. Upon application therefore, the lessee shall be granted a hearing on any notice or demand of said Board before the lease shall be declared forfeited or cancelled.

9. SURRENDER OF PREMISES. Upon the termination of this lease for any cause the lessee shall surrender possession of the leased premises to the lessor subject to lessee's right to re-enter, hereby granted, at any time within six months after the date of such termination, for the purpose of removing all machinery and improvements belonging to the lessee except those improvements as are necessary for the preservation of the mine or deposit, which shall become the property of lessor. If any of the property of lessee is not removed from the leased premises as herein provided the same shall be deemed forfeited to the lessor and become its property.

10. PROTECTION OF THE SURFACE, NATURAL RESOURCES, AND IMPROVEMENTS. The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the lessor or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the stripped area and spoil banks to a condition in keeping with the concept of the best beneficial use, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the lessor and improvements thereon.

11. TAXES. The lessee shall pay when due all taxes lawfully assessed and levied upon improvements, output of mines, or other rights, property or assets of the lessee.

12. SUCCESSORS IN INTEREST. Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors or assigns of the respective parties hereto.

IN WITNESS WHEREOF, the parties hereto set their hands and the lessor has caused this agreement to be executed with the official seal of the State Board of Land Commissioners on this 22nd day of July, 1963.

THE STATE OF MONTANA, LESSOR

By Its State Board of Land Commissioners.

FORREST H. ANDERSON

President

Secretary

Lessee

Attest:

P. O. Box 746

Address of Lessee: Sheridan, Wyoming 82801

The lessee agrees to comply with all applicable laws and regulations in effect at the date of this lease, or which may, from time to time, be adopted and which do not impair the obligations of this contract and which do not deprive the lessee of an existing property right recognized by law.

Commissioner of State Lands and Investments

DECKER COAL COMPANY

Lessee

SEAL

P. O. Box 746 - Sheridan, Wyoming 82801

Address of Lessee

COAL LEASE FORM NO. 1
Under Chapter 5, Title 81, R.C.M. 19

EXCHANGE

No. C-527-63

State of Montana
COAL LEASE

Lessee Decker Coal Company

Address Sheridan, Wyoming
82801

In Effect From November 13, 19

Exchange
Date Granted by Board Sept. 8, 1

Checked by

Fees and Rental Entered 9/8/71

Registered November 13, 1963

By

20M-11-57-217

State of Montana

COAL LEASE

EXCHANGE

Lease No. C-530-65

This indenture of lease, made and entered into between the State of Montana, by and through its lawfully qualified and acting State Board of Land Commissioners, hereinafter referred to as lessor, and the person, company or corporation herein named, hereinafter referred to as lessee, under and pursuant to the terms and provisions of Chapter 5, Title 81, Revised Codes of Montana, 1947, and all acts amendatory thereof and supplementary thereto, WITNESSETH:

The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee, for the purpose of mining and disposing of coal and constructing all such works, buildings, plants, structures and appliances as may be necessary and convenient to produce, save, care for, dispose of and remove said coal, all the lands herein described, as follows:

Date this lease takes effect: **April 14, 1965**Name of Lessee: **Decker Coal Company**
P. O. Box 746Address of Lessee: **Sheridan, Wyoming 82801**Land located in: **Big Horn** county.Description of Land: **Township 9 South, Range 41 East**
Section 16: AllTotal number of acres **640**, more or less, belonging to **School** Grant.Annual Rental, Payable each year in advance, **\$1.00 per acre for the first ten years.**
\$5.00 per acre for the eleventh through the
twentieth year. \$3,200.00 Exchange Lease Fee.

TO HAVE AND TO HOLD the said premises for a term of 20 years, together with the right, provided lessee has complied with all of the terms and conditions hereof, to lease said land for additional, successive 20-year terms. If lessee shall elect to extend this lease, lessee shall so notify lessor in writing at least 90 days prior to the expiration of the original term, or any renewal term, as the case may be. Lessor expressly reserves the right reasonably to readjust and fix royalties payable hereunder and other terms and conditions of this lease in the event lessee exercises its right to renew. Unless lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for the ensuing 20-year renewal, lessee shall be deemed to have agreed to such terms.

IT IS MUTUALLY UNDERSTOOD, AGREED AND COVENANTED BY AND BETWEEN THE PARTIES TO THIS LEASE AS FOLLOWS:

1. RIGHTS RESERVED. The lessor expressly reserves the right to sell, lease, or otherwise dispose of any interest or estate in the lands hereby leased, except the interest conveyed by this lease, provided that the lessor hereby agrees that sales, leases or other dispositions of any interest or estate in the lands hereby leased shall be subject to the terms of this lease, and shall not interfere with the lessee's possession or rights hereunder.

2. BOND. The lessee shall immediately upon the execution of this lease furnish a surety bond in the amount of \$1000.00 conditioned upon compliance with the provisions of this lease or, in the option of the lessor, a cash deposit in the amount of \$1000.00.

3. RENTAL. The lessee shall pay the lessor annually, in advance, for each acre or fraction thereof covered by this lease, beginning with the date this lease takes effect, the following rentals: As above for the first year;

As above per year for the second, third, fourth, and fifth years, respectively; and As above for the sixth and each succeeding year of this lease such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid. In no case shall the annual rental payable hereunder be less than Fifty (\$50.00) dollars.

4. ROYALTY. The lessee shall pay the lessor a royalty on every ton of 2,000 pounds of coal mined during the term of the lease, said royalty to be at the rate of 15¢ per ton on lignite coal and 17¢ per ton on sub-bituminous coal, type of coal to be determined when production occurs. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

5. REPORTS. At such times and in such form as the lessor shall prescribe, the lessee shall furnish to lessor and to the Montana state bureau of mines and geology reports, plats and maps showing exploration data, development work, improvements, amount of leased deposits mined, and any other information with respect to the land leased which the lessor may require.

6. INSPECTION. The lessee shall permit at all reasonable times inspection by the lessor or the Montana State bureau of mines and geology of the leased premises and all books and records pertaining to operations and surveys or investigations under this lease. The lessee shall also permit the lessor or the Montana state bureau of mines and geology to make copies of and extracts from all books and records pertaining to operations under this lease.

7. ASSIGNMENT. This lease may not be assigned without the prior approval of the lessor in writing.

8. **TERMINATION.** The lessee shall have the right at the termination of any rental year, by giving at least 30 days previous notice in writing to the Commissioner of State Lands and Investments to surrender and relinquish this lease and thereupon be discharged from any obligation not theretofore accrued. The lessor may declare this lease forfeited and cancel the same through the State Board of Land Commissioners upon failure of the lessee to fully comply with the terms of this lease, after written notice from said board and reasonable time fixed and allowed by it to the lessee to perform the undertaking or obligation specified in said notice. Upon application therefore, the lessee shall be granted a hearing on any notice or demand of said Board before the lease shall be declared forfeited or cancelled.

9. **SURRENDER OF PREMISES.** Upon the termination of this lease for any cause the lessee shall surrender possession of the leased premises to the lessor subject to lessee's right to re-enter, hereby granted, at any time within six months after the date of such termination, for the purpose of removing all machinery and improvements belonging to the lessee except those improvements as are necessary for the preservation of the mine or deposit, which shall become the property of lessor. If any of the property of lessee is not removed from the leased premises as herein provided the same shall be deemed forfeited to the lessor and become its property.

10. **PROTECTION OF THE SURFACE, NATURAL RESOURCES, AND IMPROVEMENTS.** The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the lessor or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the stripped area and spoil banks to a condition in keeping with the concept of the best beneficial use, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the lessor and improvements thereon.

11. **TAXES.** The lessee shall pay when due all taxes lawfully assessed and levied upon improvements, output of mines, or other rights, property or assets of the lessee.

12. **SUCCESSORS IN INTEREST.** Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors or assigns of the respective parties hereto.

IN WITNESS WHEREOF, the parties hereto set their hands and the lessor has caused this agreement to be executed with the official seal of the State Board of Land Commissioners on this 10 day of April, 1965.

THE STATE OF MONTANA, LESSOR

By Its State Board of Land Commissioners:

FORREST H. ANDERSON

President

Secretary

Lessee

P. O. Box 746

Address of Lessee. Sheridan, Wyoming 82801

Attest:

The lessee agrees to comply with all applicable laws and regulations in effect at the date of this lease, or which may, from time to time, be adopted and which do not impair the obligations of this contract and which do not deprive the lessee of an existing property right recognized by law.

Commissioner of State Lands and Investments

DECEASED

Lessee

SEAL

Address of Lessee

COAL LEASE FORM NO. 1
Under Chapter 5, Title 81, R.C.M. 1973

Exchange No. C-530-65

State of Montana
COAL LEASE

Decker Coal Compan
Lessee

Address Sheridan, Wyoming
82801

In Effect From April 14, 1965

Exchange
Date Granted by Board September

Checked by

Fees and Rental Entered 9/8/71

Registered April 14, 1965

By

2M-11-57-217

State of Montana

COAL LEASE

EXCHANGE

Lease No. C-531-65

This indenture of lease, made and entered into between the State of Montana, by and through its lawfully qualified and acting State Board of Land Commissioners, hereinafter referred to as lessor, and the person, company or corporation herein named, hereinafter referred to as lessee, under and pursuant to the terms and provisions of Chapter 5, Title 81, Revised Codes of Montana, 1947, and all acts amendatory thereof and supplementary thereto, WITNESSETH:

The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee, for the purpose of mining and disposing of coal and constructing all such works, buildings, plants, structures and appliances as may be necessary and convenient to produce, save, care for, dispose of and remove said coal, all the lands herein described, as follows:

Date this lease takes effect: April 14, 1965

Name of Lessee: Decker Coal Company
P. O. Box 746
 Address of Lessee: Sheridan, Wyoming 82801

Land located in: Big Horn county.

Description of Land: Township 9 South, Range 40 East
Section 12: E $\frac{1}{2}$, E $\frac{1}{2}$ SW $\frac{1}{4}$

Total number of acres 400, more or less, belonging to School Grant.

Annual Rental, Payable each year in advance, \$1.00 per acre for the first ten years.
\$5.00 per acre for the eleventh through the
twentieth year. \$4,000.00 Exchange Lease Fee.

TO HAVE AND TO HOLD the said premises for a term of 20 years, together with the right, provided lessee has complied with all of the terms and conditions hereof, to lease said land for additional, successive 20-year terms. If lessee shall elect to extend this lease, lessee shall so notify lessor in writing at least 90 days prior to the expiration of the original term, or any renewal term, as the case may be. Lessor expressly reserves the right reasonably to readjust and fix royalties payable hereunder and other terms and conditions of this lease in the event lessee exercises its right to renew. Unless lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for the ensuing 20-year renewal, lessee shall be deemed to have agreed to such terms.

IT IS MUTUALLY UNDERSTOOD, AGREED AND COVENANTED BY AND BETWEEN THE PARTIES TO THIS LEASE AS FOLLOWS:

1. RIGHTS RESERVED. The lessor expressly reserves the right to sell, lease, or otherwise dispose of any interest or estate in the lands hereby leased, except the interest conveyed by this lease, provided that the lessor hereby agrees that sales, leases or other dispositions of any interest or estate in the lands hereby leased shall be subject to the terms of this lease, and shall not interfere with the lessee's possession or rights hereunder.

2. BOND. The lessee shall immediately upon the execution of this lease furnish a surety bond in the amount of \$1000.00 conditioned upon compliance with the provisions of this lease or, in the option of the lessor, a cash deposit in the amount of \$1000.00.

3. RENTAL. The lessee shall pay the lessor annually, in advance, for each acre or fraction thereof covered by this lease, beginning with the date this lease takes effect, the following rentals: As above for the first year; As above per year for the second, third, fourth, and fifth years, respectively; and As above for the sixth and each succeeding year of this lease such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid. In no case shall the annual rental payable hereunder be less than Fifty (\$50.00) dollars.

4. ROYALTY. The lessee shall pay the lessor a royalty on every ton of 2,000 pounds of coal mined during the term of the lease, said royalty to be at the rate of 15¢ per ton on lignite coal and 17½¢ per ton on sub-bituminous coal, type of coal to be determined when production occurs. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

5. REPORTS. At such times and in such form as the lessor shall prescribe, the lessee shall furnish to lessor and to the Montana state bureau of mines and geology reports, plats and maps showing exploration data, development work, improvements, amount of leased deposits mined, and any other information with respect to the land leased which the lessor may require.

6. INSPECTION. The lessee shall permit at all reasonable times inspection by the lessor or the Montana State bureau of mines and geology of the leased premises and all books and records pertaining to operations and surveys or investigations under this lease. The lessee shall also permit the lessor or the Montana state bureau of mines and geology to make copies of and extracts from all books and records pertaining to operations under this lease.

7. ASSIGNMENT. This lease may not be assigned without the prior approval of the lessor in writing.

8. **TERMINATION.** The lessee shall have the right at the termination of any rental year, by giving at least 30 days previous notice in writing to the Commissioner of State Lands and Investments to surrender and relinquish this lease and thereupon be discharged from any obligation not theretofore accrued. The lessor may declare this lease forfeited and cancel the same through the State Board of Land Commissioners upon failure of the lessee to fully comply with the terms of this lease, after written notice from said board and reasonable time fixed and allowed by it to the lessee to perform the undertaking or obligation specified in said notice. Upon application therefore, the lessee shall be granted a hearing on any notice or demand of said Board before the lease shall be declared forfeited or cancelled.

9. **SURRENDER OF PREMISES.** Upon the termination of this lease for any cause the lessee shall surrender possession of the leased premises to the lessor subject to lessee's right to re-enter, hereby granted, at any time within six months after the date of such termination, for the purpose of removing all machinery and improvements belonging to the lessee except those improvements as are necessary for the preservation of the mine or deposit, which shall become the property of lessor. If any of the property of lessee is not removed from the leased premises as herein provided the same shall be deemed forfeited to the lessor and become its property.

10. **PROTECTION OF THE SURFACE, NATURAL RESOURCES, AND IMPROVEMENTS.** The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the lessor or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the stripped area and spoil banks to a condition in keeping with the concept of the best beneficial use, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the lessor and improvements thereon.

11. **TAXES.** The lessee shall pay when due all taxes lawfully assessed and levied upon improvements, output of mines, or other rights, property or assets of the lessee.

12. **SUCCESSORS IN INTEREST.** Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors or assigns of the respective parties hereto.

IN WITNESS WHEREOF, the parties hereto set their hands and the lessor has caused this agreement to be executed with the official seal of the State Board of Land Commissioners on this _____ day of _____, 19____.

THE STATE OF MONTANA, LESSOR

By Its State Board of Land Commissioners.

FORREST H. ANDERSON

President

Secretary

Lessee

P. O. Box 746

Address of Lessee Sheridan, Wyoming 82801

Attest:

The lessee agrees to comply with all applicable laws and regulations in effect at the date of this lease, or which may, from time to time, be adopted and which do not impair the obligations of this contract and which do not deprive the lessee of an existing property right recognized by law.

Commissioner of State Lands and Investments

DECKER COAL COMPANY

Lessee

Address of Lessee

P. O. Box 746-Sheridan, Wyoming 82801

Address of Lessee

SEAL

COAL LEASE FORM NO. 1
Under Chapter 5, Title 81, R.C.M.

EXCHANGE No. C-531-65

State of Montana
COAL LEASE

Lessee Decker Coal Company

Address Sheridan, Wyoming
82801

In Effect From April 14, 19

Exchange
Date Granted by Board Septemb

Checked by _____

Fees and Rental Entered 9/8/7

Registered April 14, 1965

By _____

23-11-67-217

State of Montana

COAL LEASE

EXCHANGELease No. C-322-66

This indenture of lease, made and entered into between the State of Montana, by and through its lawfully qualified and acting State Board of Land Commissioners, hereinafter referred to as lessor, and the person, company or corporation herein named, hereinafter referred to as lessee, under and pursuant to the terms and provisions of Chapter 5, Title 81, Revised Codes of Montana, 1947, and all acts amendatory thereof and supplementary thereto, WITNESSETH:

The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee, for the purpose of mining and disposing of coal and constructing all such works, buildings, plants, structures and appliances as may be necessary and convenient to produce, save, care for, dispose of and remove said coal, all the lands herein described, as follows:

Date this lease takes effect: **June 2, 1966**

Name of Lessee: **Decker Coal Company**
P. O. Box 746
 Address of Lessee: **Sheridan, Wyoming 82801**
 Land located in: **Big Horn** county.

Description of Land: **Township 9 South, Range 40 East**
Section 11: S $\frac{1}{2}$ SE $\frac{1}{4}$

Total number of acres **80**, more or less, belonging to **School** Grant.

Annual Rental, Payable each year in advance, **\$1.00 per acre for the first ten years.**
\$5.00 per acre for the eleventh through the
twentieth year. \$800.00 Exchange Lease Fee.

TO HAVE AND TO HOLD the said premises for a term of 20 years, together with the right, provided lessee has complied with all of the terms and conditions hereof, to lease said land for additional, successive 20-year terms. If lessee shall elect to extend this lease, lessee shall so notify lessor in writing at least 90 days prior to the expiration of the original term, or any renewal term, as the case may be. Lessor expressly reserves the right reasonably to readjust and fix royalties payable hereunder and other terms and conditions of this lease in the event lessee exercises its right to renew. Unless lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for the ensuing 20-year renewal, lessee shall be deemed to have agreed to such terms.

IT IS MUTUALLY UNDERSTOOD, AGREED AND COVENANTED BY AND BETWEEN THE PARTIES TO THIS LEASE AS FOLLOWS:

1. **RIGHTS RESERVED.** The lessor expressly reserves the right to sell, lease, or otherwise dispose of any interest or estate in the lands hereby leased, except the interest conveyed by this lease, provided that the lessor hereby agrees that sales, leases or other dispositions of any interest or estate in the lands hereby leased shall be subject to the terms of this lease, and shall not interfere with the lessee's possession or rights hereunder.

2. **BOND.** The lessee shall immediately upon the execution of this lease furnish a surety bond in the amount of **\$1000.00** conditioned upon compliance with the provisions of this lease or, in the option of the lessor, a cash deposit in the amount of **\$1000.00**

3. **RENTAL.** The lessee shall pay the lessor annually, in advance, for each acre or fraction thereof covered by this lease, beginning with the date this lease takes effect, the following rentals: **As above** for the first year; **As above** per year for the second, third, fourth, and fifth years, respectively; and _____ for the sixth and each succeeding year of this lease such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid. In no case shall the annual rental payable hereunder be less than Fifty (\$50.00) dollars.

4. **ROYALTY.** The lessee shall pay the lessor a royalty on every ton of 2,000 pounds of coal mined during the term of the lease, said royalty to be at the rate of **15¢** per ton on lignite coal and **17½¢** per ton on sub-bituminous coal, type of coal to be determined when production occurs. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

5. **REPORTS.** At such times and in such form as the lessor shall prescribe, the lessee shall furnish to lessor and to the Montana state bureau of mines and geology reports, plats and maps showing exploration data, development work, improvements, amount of leased deposits mined, and any other information with respect to the land leased which the lessor may require.

6. **INSPECTION.** The lessee shall permit at all reasonable times inspection by the lessor or the Montana State bureau of mines and geology of the leased premises and all books and records pertaining to operations and surveys or investigations under this lease. The lessee shall also permit the lessor or the Montana state bureau of mines and geology to make copies of and extracts from all books and records pertaining to operations under this lease.

7. **ASSIGNMENT.** This lease may not be assigned without the prior approval of the lessor in writing.

8. **TERMINATION.** The lessee shall have the right at the termination of any rental year, by giving at least 30 days previous notice in writing to the Commissioner of State Lands and Investments to surrender and relinquish this lease and thereupon be discharged from any obligation not theretofore accrued. The lessor may declare this lease forfeited and cancel the same through the State Board of Land Commissioners upon failure of the lessee to fully comply with the terms of this lease, after written notice from said board and reasonable time fixed and allowed by it to the lessee to perform the undertaking or obligation specified in said notice. Upon application therefore, the lessee shall be granted a hearing on any notice or demand of said Board before the lease shall be declared forfeited or cancelled.

9. **SURRENDER OF PREMISES.** Upon the termination of this lease for any cause the lessee shall surrender possession of the leased premises to the lessor subject to lessee's right to re-enter, hereby granted, at any time within six months after the date of such termination, for the purpose of removing all machinery and improvements belonging to the lessee except those improvements as are necessary for the preservation of the mine or deposit, which shall become the property of lessor. If any of the property of lessee is not removed from the leased premises as herein provided the same shall be deemed forfeited to the lessor and become its property.

10. **PROTECTION OF THE SURFACE, NATURAL RESOURCES, AND IMPROVEMENTS.** The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the lessor or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the stripped area and spoil banks to a condition in keeping with the concept of the best beneficial use, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the lessor and improvements thereon.

11. **TAXES.** The lessee shall pay when due all taxes lawfully assessed and levied upon improvements, output of mines, or other rights, property or assets of the lessee.

12. **SUCCESSORS IN INTEREST.** Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors or assigns of the respective parties hereto.

IN WITNESS WHEREOF, the parties hereto set their hands and the lessor has caused this agreement to be executed with the official seal of the State Board of Land Commissioners on this 15th day of April, 1927

THE STATE OF MONTANA, LESSOR
By Its State Board of Land Commissioners.

FORREST H. ANDERSON

President

Attest:

Secretary

Lessee

P. O. Box 746

Address of Lessee Sheridan, Wyoming 82801

The lessee agrees to comply with all applicable laws and regulations in effect at the date of this lease, or which may, from time to time, be adopted and which do not impair the obligations of this contract and which do not deprive the lessee of an existing property right recognized by law.

Ed Anderson
Commissioner of State Lands and Investments

DECKER COAL COMPANY

Lessee

SEAL

Ed Anderson
P. O. Box 746 - Sheridan, Wyoming 82801

Address of Lessee

COAL LEASE FORM NO. 1
Under Chapter 5, Title 81, R.C.M. 194

EXCHANGE No. C-822-66

State of Montana
COAL LEASE

Lessee Decker Coal Company

Address Sheridan, Wyoming

In Effect From June 2, 1966

Exchange
Date Granted by Board September 1

Checked by Ed Anderson

Fees and Rental Entered 9/8/71

Registered June 2, 1966

By Ed Anderson

5-11-67-217

State of Montana

COAL LEASE

EXCHANGE

Lease No. C-823-66

This indenture of lease, made and entered into between the State of Montana, by and through its lawfully qualified and acting State Board of Land Commissioners, hereinafter referred to as lessor, and the person, company or corporation herein named, hereinafter referred to as lessee, under and pursuant to the terms and provisions of Chapter 5, Title 81, Revised Codes of Montana, 1947, and all acts amendatory thereof and supplementary thereto, WITNESSETH:

The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee, for the purpose of mining and disposing of coal and constructing all such works, buildings, plants, structures and appliances as may be necessary and convenient to produce, save, care for, dispose of and remove said coal, all the lands herein described, as follows:

Date this lease takes effect: June 2, 1966

Name of Lessee: Decker Coal Company
P. O. Box 746
 Address of Lessee: Sheridan, Wyoming 82801

Land located in Big Horn county.

Description of Land: Township 9 South, Range 40 East
Section 14 - 141E1

Total number of acres 80, more or less, belonging to School Grant.

Annual Rental, Payable each year in advance, \$1.00 per acre for the first ten years.
\$5.00 per acre for the eleventh through the
twentieth year. \$800.00 Exchange Lease Fee.

TO HAVE AND TO HOLD the said premises for a term of 20 years, together with the right, provided lessee has complied with all of the terms and conditions hereof, to lease said land for additional, successive 20-year terms. If lessee shall elect to extend this lease, lessee shall so notify lessor in writing at least 90 days prior to the expiration of the original term, or any renewal term, as the case may be. Lessor expressly reserves the right reasonably to readjust and fix royalties payable hereunder and other terms and conditions of this lease in the event lessee exercises its right to renew. Unless lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for the ensuing 20-year renewal, lessee shall be deemed to have agreed to such terms.

IT IS MUTUALLY UNDERSTOOD, AGREED AND COVENANTED BY AND BETWEEN THE PARTIES TO THIS LEASE AS FOLLOWS:

1. **RIGHTS RESERVED.** The lessor expressly reserves the right to sell, lease, or otherwise dispose of any interest or estate in the lands hereby leased, except the interest conveyed by this lease, provided that the lessor hereby agrees that sales, leases or other dispositions of any interest or estate in the lands hereby leased shall be subject to the terms of this lease, and shall not interfere with the lessee's possession or rights hereunder.

2. **BOND.** The lessee shall immediately upon the execution of this lease furnish a surety bond in the amount of \$1000.00 conditioned upon compliance with the provisions of this lease or, in the option of the lessor, a cash deposit in the amount of \$1000.00.

3. **RENTAL.** The lessee shall pay the lessor annually, in advance, for each acre or fraction thereof covered by this lease, beginning with the date this lease takes effect, the following rentals: As above for the first year; As above per year for the second, third, fourth, and fifth years, respectively; and As above for the sixth and each succeeding year of this lease such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid. In no case shall the annual rental payable hereunder be less than Fifty (\$50.00) dollars.

4. **ROYALTY.** The lessee shall pay the lessor a royalty on every ton of 2,000 pounds of coal mined during the term of the lease, said royalty to be at the rate of 15¢ per ton on lignite coal and 17½¢ per ton on sub-bituminous coal, type of coal to be determined when production occurs. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

5. **REPORTS.** At such times and in such form as the lessor shall prescribe, the lessee shall furnish to lessor and to the Montana state bureau of mines and geology reports, plats and maps showing exploration data, development work, improvements, amount of leased deposits mined, and any other information with respect to the land leased which the lessor may require.

6. **INSPECTION.** The lessee shall permit at all reasonable times inspection by the lessor or the Montana State bureau of mines and geology of the leased premises and all books and records pertaining to operations and surveys or investigations under this lease. The lessee shall also permit the lessor or the Montana state bureau of mines and geology to make copies of and extracts from all books and records pertaining to operations under this lease.

7. **ASSIGNMENT.** This lease may not be assigned without the prior approval of the lessor in writing.

8. **TERMINATION.** The lessee shall have the right at the termination of any rental year, by giving at least 30 days previous notice in writing to the Commissioner of State Lands and Investments to surrender and relinquish this lease and thereupon be discharged from any obligation not theretofore accrued. The lessor may declare this lease forfeited and cancel the same through the State Board of Land Commissioners upon failure of the lessee to fully comply with the terms of this lease, after written notice from said board and reasonable time fixed and allowed by it to the lessee to perform the undertaking or obligation specified in said notice. Upon application therefore, the lessee shall be granted a hearing on any notice or demand of said Board before the lease shall be declared forfeited or cancelled.

9. **SURRENDER OF PREMISES.** Upon the termination of this lease for any cause the lessee shall surrender possession of the leased premises to the lessor subject to lessee's right to re-enter, hereby granted, at any time within six months after the date of such termination, for the purpose of removing all machinery and improvements belonging to the lessee except those improvements as are necessary for the preservation of the mine or deposit, which shall become the property of lessor. If any of the property of lessee is not removed from the leased premises as herein provided the same shall be deemed forfeited to the lessor and become its property.

10. **PROTECTION OF THE SURFACE, NATURAL RESOURCES, AND IMPROVEMENTS.** The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the lessor or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the stripped area and spoil banks to a condition in keeping with the concept of the best beneficial use, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the lessor and improvements thereon.

11. **TAXES.** The lessee shall pay when due all taxes lawfully assessed and levied upon improvements, output of mines, or other rights, property or assets of the lessee.

12. **SUCCESSORS IN INTEREST.** Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors or assigns of the respective parties hereto.

IN WITNESS WHEREOF, the parties hereto set their hands and the lessor has caused this agreement to be executed with the official seal of the State Board of Land Commissioners on this 14 day of June, 1971

THE STATE OF MONTANA, LESSOR

By Its State Board of Land Commissioners,

FORREST H. ANDERSON

President

Attest:

Secretary

Lessee

P. O. Box 746

Address of Lessee Sheridan, Wyoming 82801

The lessee agrees to comply with all applicable laws and regulations in effect at the date of this lease, or which may, from time to time, be adopted and which do not impair the obligations of this contract and which do not deprive the lessee of an existing property right recognized by law.

Forrest H. Anderson
Commissioner of State Lands and Investments

DECKER COAL COMPANY

Lessee

SEAL

Forrest H. Anderson
P. O. Box 746 - Sheridan, Wyoming 82801

Address of Lessee

COAL LEASE FORM NO. 1
Under Chapter 5, Title 81, R.C.M. 19

EXCHANGE No. C-823-66

State of Montana
COAL LEASE

Lessee Decker Coal Company

Address Sheridan, Wyoming

In Effect From June 2, 1966

Exchange
Date Granted by Board September

Checked by

Fees and Rental Entered 9/8/71

Registered June 2, 1966

By

231-11-67-217

State of Montana

COAL LEASE

EXCHANGE

Lease No. C-918-67

This indenture of lease, made and entered into between the State of Montana, by and through its lawfully qualified and acting State Board of Land Commissioners, hereinafter referred to as lessor, and the person, company or corporation herein named, hereinafter referred to as lessee, under and pursuant to the terms and provisions of Chapter 5, Title 81, Revised Codes of Montana, 1947, and all acts amendatory thereof and supplementary thereto, WITNESSETH:

The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee, for the purpose of mining and disposing of coal and constructing all such works, buildings, plants, structures and appliances as may be necessary and convenient to produce, save, care for, dispose of and remove said coal, all the lands herein described, as follows:

Date this lease takes effect: **April 12, 1967**Name of Lessee: **Decker Coal Company**
P. O. Box 746Address of Lessee: **Sheridan, Wyoming 82801**Land located in: **Big Horn** county.Description of Land: **Township 9 South, Range 40 East**
Section 12: W4SW4Total number of acres **80**, more or less, belonging to **School** Grant.

Annual Rental, Payable each year in advance, **\$1.00 per acre for the first ten years.**
\$5.00 per acre for the eleventh through the
twentieth year. \$800.00 Exchange Lease Fee.

TO HAVE AND TO HOLD the said premises for a term of 20 years, together with the right, provided lessee has complied with all of the terms and conditions hereof, to lease said land for additional, successive 20-year terms. If lessee shall elect to extend this lease, lessee shall so notify lessor in writing at least 90 days prior to the expiration of the original term, or any renewal term, as the case may be. Lessor expressly reserves the right reasonably to readjust and fix royalties payable hereunder and other terms and conditions of this lease in the event lessee exercises its right to renew. Unless lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for the ensuing 20-year renewal, lessee shall be deemed to have agreed to such terms.

IT IS MUTUALLY UNDERSTOOD, AGREED AND COVENANTED BY AND BETWEEN THE PARTIES TO THIS LEASE AS FOLLOWS:

1. RIGHTS RESERVED. The lessor expressly reserves the right to sell, lease, or otherwise dispose of any interest or estate in the lands hereby leased, except the interest conveyed by this lease, provided that the lessor hereby agrees that sales, leases or other dispositions of any interest or estate in the lands hereby leased shall be subject to the terms of this lease, and shall not interfere with the lessee's possession or rights hereunder.

2. BOND. The lessee shall immediately upon the execution of this lease furnish a surety bond in the amount of \$1000.00 conditioned upon compliance with the provisions of this lease or, in the option of the lessor, a cash deposit in the amount of \$1000.00

3. RENTAL. The lessee shall pay the lessor annually, in advance, for each acre or fraction thereof covered by this lease, beginning with the date this lease takes effect, the following rentals: As above for the first year; As above per year for the second, third, fourth, and fifth years, respectively; and As above for the sixth and each succeeding year of this lease such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid. In no case shall the annual rental payable hereunder be less than Fifty (\$50.00) dollars.

4. ROYALTY. The lessee shall pay the lessor a royalty on every ton of 2,000 pounds of coal mined during the term of the lease, said royalty to be at the rate of 15¢ per ton on lignite coal and 17½¢ per ton on sub-bituminous coal, type of coal to be determined when production occurs. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

5. REPORTS. At such times and in such form as the lessor shall prescribe, the lessee shall furnish to lessor and to the Montana state bureau of mines and geology reports, plats and maps showing exploration data, development work, improvements, amount of leased deposits mined, and any other information with respect to the land leased which the lessor may require.

6. INSPECTION. The lessee shall permit at all reasonable times inspection by the lessor or the Montana State bureau of mines and geology of the leased premises and all books and records pertaining to operations and surveys or investigations under this lease. The lessee shall also permit the lessor or the Montana state bureau of mines and geology to make copies of and extracts from all books and records pertaining to operations under this lease.

7. ASSIGNMENT. This lease may not be assigned without the prior approval of the lessor in writing.

8. **TERMINATION.** The lessee shall have the right at the termination of any rental year, by giving at least 30 days previous notice in writing to the Commissioner of State Lands and Investments to surrender and relinquish this lease and thereupon be discharged from any obligation not theretofore accrued. The lessor may declare this lease forfeited and cancel the same through the State Board of Land Commissioners upon failure of the lessee to fully comply with the terms of this lease, after written notice from said board and reasonable time fixed and allowed by it to the lessee to perform the undertaking or obligation specified in said notice. Upon application therefore, the lessee shall be granted a hearing on any notice or demand of said Board before the lease shall be declared forfeited or cancelled.

9. **SURRENDER OF PREMISES.** Upon the termination of this lease for any cause the lessee shall surrender possession of the leased premises to the lessor subject to lessee's right to re-enter, hereby granted, at any time within six months after the date of such termination, for the purpose of removing all machinery and improvements belonging to the lessee except those improvements as are necessary for the preservation of the mine or deposit, which shall become the property of lessor. If any of the property of lessee is not removed from the leased premises as herein provided the same shall be deemed forfeited to the lessor and become its property.

10. **PROTECTION OF THE SURFACE, NATURAL RESOURCES, AND IMPROVEMENTS.** The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the lessor or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the stripped area and spoil banks to a condition in keeping with the concept of the best beneficial use, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the lessor and improvements thereon.

11. **TAXES.** The lessee shall pay when due all taxes lawfully assessed and levied upon improvements, output of mines, or other rights, property or assets of the lessee.

12. **SUCCESSORS IN INTEREST.** Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors or assigns of the respective parties hereto.

IN WITNESS WHEREOF, the parties hereto set their hands and the lessor has caused this agreement to be executed with the official seal of the State Board of Land Commissioners on this 12 day of March, 1967.

THE STATE OF MONTANA, LESSOR

By Its State Board of Land Commissioners.

FORREST H. ANDERSON

President

Secretary

P. O. Box 746

Lessee

Address of Lessee

Sheridan, Wyoming 82801

Attest:

The lessee agrees to comply with all applicable laws and regulations in effect at the date of this lease, or which may, from time to time, be adopted and which do not impair the obligations of this contract and which do not deprive the lessee of an existing property right recognized by law.

Forrest H. Anderson
Commissioner of State Lands and Investments

DECKER COAL COMPANY

Lessee

SEAL

Forrest H. Anderson
P. O. Box 746 - Sheridan, Wyoming 82801

Address of Lessee

COAL LEASE FORM NO. 1
Under Chapter 5, Title 81, R.C.M. 1967

Exchange No. C-918-67

State of Montana
COAL LEASE

Lessee Decker Coal Company

Address Sheridan, Wyoming

In Effect From April 12, 1967

Exchange
Date Granted by Board September

Checked by Forrest H. Anderson

Fees and Rental Entered 9/8/71

Registered April 12, 1967

By Forrest H. Anderson

14-11-07-217

State of Montana

COAL LEASE

EXCHANGE

Lease No. C-919-67

This indenture of lease, made and entered into between the State of Montana, by and through its lawfully qualified and acting State Board of Land Commissioners, hereinafter referred to as lessor, and the person, company or corporation herein named, hereinafter referred to as lessee, under and pursuant to the terms and provisions of Chapter 5, Title 81, Revised Codes of Montana, 1947, and all acts amendatory thereof and supplementary thereto, WITNESSETH:

The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee, for the purpose of mining and disposing of coal and constructing all such works, buildings, plants, structures and appliances as may be necessary and convenient to produce, save, care for, dispose of and remove said coal, all the lands herein described, as follows:

Date this lease takes effect: **April 12, 1967**

Name of Lessee: **Decker Coal Company**
P. O. Box 746
 Address of Lessee: **Sheridan, Wyoming 82801**

Land located in **Big Horn** county.

Description of Land: **Township 8 South, Range 40 East**
Section 36: All

Total number of acres **640**, more or less, belonging to **School** Grant.

Annual Rental, Payable each year in advance, \$1.00 per acre for the first ten years.
\$5.00 per acre for the eleventh through the
twentieth year. \$3,200.00 Exchange Lease Fee.

TO HAVE AND TO HOLD the said premises for a term of 20 years, together with the right, provided lessee has complied with all of the terms and conditions hereof, to lease said land for additional, successive 20-year terms. If lessee shall elect to extend this lease, lessee shall so notify lessor in writing at least 90 days prior to the expiration of the original term, or any renewal term, as the case may be. Lessor expressly reserves the right reasonably to readjust and fix royalties payable hereunder and other terms and conditions of this lease in the event lessee exercises its right to renew. Unless lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for the ensuing 20-year renewal, lessee shall be deemed to have agreed to such terms.

IT IS MUTUALLY UNDERSTOOD, AGREED AND COVENANTED BY AND BETWEEN THE PARTIES TO THIS LEASE AS FOLLOWS:

1. **RIGHTS RESERVED.** The lessor expressly reserves the right to sell, lease, or otherwise dispose of any interest or estate in the lands hereby leased, except the interest conveyed by this lease, provided that the lessor hereby agrees that sales, leases or other dispositions of any interest or estate in the lands hereby leased shall be subject to the terms of this lease, and shall not interfere with the lessee's possession or rights hereunder.

2. **BOND.** The lessee shall immediately upon the execution of this lease furnish a surety bond in the amount of \$1000.00 conditioned upon compliance with the provisions of this lease or, in the option of the lessor, a cash deposit in the amount of \$1000.00.

3. **RENTAL.** The lessee shall pay the lessor annually, in advance, for each acre or fraction thereof covered by this lease, beginning with the date this lease takes effect, the following rentals: As above for the first year; As above per year for the second, third, fourth, and fifth years, respectively; and As above for the sixth and each succeeding year of this lease such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid. In no case shall the annual rental payable hereunder be less than Fifty (\$50.00) dollars.

4. **ROYALTY.** The lessee shall pay the lessor a royalty on every ton of 2,000 pounds of coal mined during the term of the lease, said royalty to be at the rate of 15¢ per ton on lignite coal and 17½¢ per ton on sub-bituminous coal, type of coal to be determined when production occurs. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

5. **REPORTS.** At such times and in such form as the lessor shall prescribe, the lessee shall furnish to lessor and to the Montana state bureau of mines and geology reports, plats and maps showing exploration data, development work, improvements, amount of leased deposits mined, and any other information with respect to the land leased which the lessor may require.

6. **INSPECTION.** The lessee shall permit at all reasonable times inspection by the lessor or the Montana State bureau of mines and geology of the leased premises and all books and records pertaining to operations and surveys or investigations under this lease. The lessee shall also permit the lessor or the Montana state bureau of mines and geology to make copies of and extracts from all books and records pertaining to operations under this lease.

7. **ASSIGNMENT.** This lease may not be assigned without the prior approval of the lessor in writing.

8. **TERMINATION.** The lessee shall have the right at the termination of any rental year, by giving at least 30 days previous notice in writing to the Commissioner of State Lands and Investments to surrender and relinquish this lease and thereupon be discharged from any obligation not theretofore accrued. The lessor may declare this lease forfeited and cancel the same through the State Board of Land Commissioners upon failure of the lessee to fully comply with the terms of this lease, after written notice from said board and reasonable time fixed and allowed by it to the lessee to perform the undertaking or obligation specified in said notice. Upon application therefore, the lessee shall be granted a hearing on any notice or demand of said Board before the lease shall be declared forfeited or cancelled.

9. **SURRENDER OF PREMISES.** Upon the termination of this lease for any cause the lessee shall surrender possession of the leased premises to the lessor subject to lessee's right to re-enter, hereby granted, at any time within six months after the date of such termination, for the purpose of removing all machinery and improvements belonging to the lessee except those improvements as are necessary for the preservation of the mine or deposit, which shall become the property of lessor. If any of the property of lessee is not removed from the leased premises as herein provided the same shall be deemed forfeited to the lessor and become its property.

10. **PROTECTION OF THE SURFACE, NATURAL RESOURCES, AND IMPROVEMENTS.** The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the lessor or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the stripped area and spoil banks to a condition in keeping with the concept of the best beneficial use, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the lessor and improvements thereon.

11. **TAXES.** The lessee shall pay when due all taxes lawfully assessed and levied upon improvements, output of mines, or other rights, property or assets of the lessee.

12. **SUCCESSORS IN INTEREST.** Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors or assigns of the respective parties hereto.

IN WITNESS WHEREOF, the parties hereto set their hands and the lessor has caused this agreement to be executed with the official seal of the State Board of Land Commissioners on this 21st day of June, 1971.

THE STATE OF MONTANA, LESSOR
By Its State Board of Land Commissioners.
FORREST H. ANDERSON

President

Attest:

Secretary

[Signature]
[Signature]
Lessee

P. O. Box 746

Address of Lessee: Sheridan, Wyoming 82801

The lessee agrees to comply with all applicable laws and regulations in effect at the date of this lease, or which may, from time to time, be adopted and which do not impair the obligations of this contract and which do not deprive the lessee of an existing property right recognized by law.

[Signature]
Commissioner of State Lands and Investments

Lessee

[Signature]

SEAL

Address of Lessee

COAL LEASE FORM NO. 1
Under Chapter 5, Title 81, R.C.M. 19-

EXCHANGE No. C-919-67

State of Montana
COAL LEASE

Lessee Duke Coal Company

Address Sheridan, Wyoming 81

In Effect From April 12, 1967

Exchange Date Granted by Board September 8

Checked by [Signature]

Fees and Rental Entered 9/8/71

Registered April 12, 1967

By [Signature]

2M-11-87-217

APPENDIX B

GEOLOGY AND SOILS

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Explanation of table B-1 (Analyses of overburden samples)

Table B-1 presents the results of analyses of samples of overburden from 17 core holes drilled in the East Decker and North Extension areas by the Decker Coal Co. (fig. 38). Analyses were made in accordance with procedures accepted by the Montana Department of State Lands. Samples from the East Decker area were analyzed by Northern Testing Laboratories, Billings, Montana; samples from the North Extension area were analyzed by Front Range Environmental Lab, Fort Collins, Colorado.

The purpose of the analyses was to determine the suitability of spoils materials derived from the overburden for use as possible soil substitutes or as a medium for plant growth, should these materials be left within rooting depth of the surface. Values reported for trace elements are those amounts that purportedly are soluble under normal soil conditions and can be extracted by plants.

Analyses were made on samples obtained from drill cores where the overburden was sufficiently indurated to permit coring. Samples of poorly indurated rocks such as soil, alluvium, clinker, or weathered sandstone and shale were necessarily obtained from drill cuttings reaching the surface and assumed to be representative of the sample interval. All samples from the East Decker area were taken from above the Dietz 2 coal bed, which is the lowest coal bed to be mined. The overburden in the North Extension area, however, was sampled from the surface to the top of the Canyon coal bed in the event that the Decker Coal Co. might be required by the Montana Department of State Lands to mine the Canyon Coal. Results of all analyses are given in table B-1.

A listing of the various analyses and guidelines for interpreting the results given in table B-1 are summarized below:

pH.--Provides a measure of the acidity or alkalinity of a sample-water mixture under two conditions: (1) a saturated paste and (2) a 1:5 sample-water dilution. A pH of 7.0 is neutral; below 7.0 is acid; above 7.0 is alkaline. A paste pH reading in excess of 8.5 usually indicates moderate to high exchangeable sodium percentage. An increase in pH reading of 1.0 or more between the paste and the 1:5 dilution may indicate a saline-alkali condition.

Soluble salts.--Provides an indication of the dissolved solids content of leachate from the sample. Measurements of specific conductance are made on a saturated soil paste. Results are reported in units of electrical conductance (millimhos/cm). In the Decker area, 1 millimho/cm is equivalent to about 900 milligrams/litre (mg/l) dissolved solids. Readings of 0 to 2 millimhos/cm indicate no adverse effect on plants. Readings of 2 to 4 millimhos/cm are considered low; only sensitive plant species would be affected. Readings of 4 to 8 millimhos/cm are medium; a number of plant species would be adversely affected. Only very salt-tolerant plant species would survive at readings above 16 millimhos/cm.

Sodium-adsorption ratio (SAR).--Calculated from the relationship
$$SAR = Na^+ / \sqrt{(Ca^{++} + Mg^{++})/2}$$
, where Na^+ , Ca^{++} , and Mg^{++} are concentrations of the respective soluble cations expressed in milliequivalents per litre (meq/l). Values of SAR below 12 indicate no adverse effect on plants. SAR's between 12 and 18 indicate a possible sodium problem. SAR's above 18 indicate a probable alteration of the physical properties of the materials with consequent adverse effects on a potential plant cover.

levels for both plants and animals when levels exceed 2 ppm.

Molybdenum (Mo).--Toxicity to plants occurs when soil materials have poor drainage, the pH is neutral to alkaline, and extractable concentrations exceed about 5 ppm. MDSL guidelines indicate possible toxicity to animals when levels exceed 0.3 ppm, depending on plant species to be grown, pH of the materials, and DTPA-extractable iron and soluble sulfate content of the materials. Dye and O'Hara (1959) state, however, that the lowest concentrations of molybdenum in forage at which symptoms to consuming animals have been evident is 5 ppm.

Mercury (Hg).--Concentrations in the overburden above the Dietz 2 coal bed range from .001 to .192. These concentrations should not present any appreciable hazards to rehabilitation. MDSL guidelines indicate toxicity when levels exceed 0.4-0.5 ppm.

Zinc (Zn).--Levels of extractable zinc up to about 10 ppm should be nontoxic. MDSL guidelines indicate toxicity when levels exceed 30-40 ppm.

Iron (Fe).--Iron should present no problems to rehabilitation.

Manganese (Mn).--Normal values of manganese in soils range from about 0.5 to 40 ppm. Concentrations considerably in excess of 40 ppm probably indicate strongly acid conditions or waterlogged strata. MDSL guidelines indicate toxicity when levels exceed 60 ppm.

Copper (Cu).--Normal values of copper in soils range from about 0.5 to 40 ppm. Concentrations in the upper part of this range probably are toxic to plants. MDSL guidelines indicate toxicity when values exceed 40 ppm.

Cadmium (Cd).--Materials containing more than 0.1 ppm extractable cadmium probably should not be buried within rooting depth.

Saturation percentage.--Water content of a saturated paste.

Generally, the higher the saturation percentage, the higher will be the clay content of the material. A high carbonaceous content has the same effect on saturation percentage as a high clay content.

Texture.--Determined by mechanical analysis after disaggregation of the sample.

Equivalent soil class.--Determined from textural analyses.

Selected elements.--Values listed are the amounts in parts per million (ppm) that are present in the overburden samples in a soluble form that can be extracted by plants. The toxicity of these elements to plant growth is summarized below. Except as noted, however, the effects of plants containing abnormally high concentrations of these elements on grazing animals generally has not been established. The effect on animals depends on factors such as soil and climatic conditions, concentrations of other elements present, plant species utilized, nutritional status of the plant cover, and management practices.

Nitrogen (NO₃) and (NH₄).--Concentrations of these nitrogen forms in excess of several ppm could be an indicator of nitrogen pollution of ground water discharging from spoil aquifers. The nitrogen would be beneficial and not toxic to plants.

Boron (B).--The range in concentration between deficiency and toxicity is narrower for boron than for any of the other elements that are essential to plant growth. Toxicity generally begins when extractable boron exceeds 2 to 3 ppm. Guidelines proposed by Montana Department of State Lands (MDSL) indicate a problem when levels exceed 8 ppm.

Selenium (Se).--A potential hazard exists when extractable selenium exceeds 1 ppm. MDSL guidelines indicate probable toxic

MDSL guidelines indicate toxicity when values exceed 0.1-1.0 ppm.

Lead (Pb).--Most compounds of lead in soil materials are relatively insoluble. Concentrations of extractable lead in excess of 1 ppm, therefore, may indicate a hazard to reclamation. MDSL guidelines indicate toxicity when levels exceed 10-15 ppm and the pH is less than 6 or when levels exceed 15-20 ppm and the pH is greater than 6.

Nickel (Ni).--Concentrations of extractable nickel in excess of 1 ppm are probably toxic to plants.

Table B-1.--Analyses of overburden samples to determine suitability for plant growth, East Decker and North Extension areas. (Data furnished by Decker Coal Co.)

[meq/l = milliequivalents per litre, ppm = parts per million, < indicates less than value shown]

| Core hole number | Depth below surface (feet) | Satur- ated paste | pH | 1:5 dilution (millimhos) | Sodium (meq/l) | Calcium (meq/l) | Mag- nesium (meq/l) | SAR | Satur- ation percent | Texture (percent) sand silt clay | Equip- valent soil class | Nitrogen | | | | | Mo (ppm) | Hg (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Cd (ppm) | Pb (ppm) | Ni (ppm) | | | | | |
|------------------|----------------------------|-------------------------|------|--------------------------------|-------------------|--------------------|---------------------------|------|----------------------------|----------------------------------------|-----------------------------------|------------------|------------------|------------|-------------|-----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----|-----|-----|-----|-----|
| | | | | | | | | | | | | Nitrate (ppm) | Ammonia (ppm) | B (ppm) | Se (ppm) | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | East Decker mine area | | | | | | | | | | | | | | |
| 1233 | 0.0 - 5.0 | 8.4 | 8.6 | 1.40 | 14.35 | 1.52 | 9.12 | 5.2 | 29.6 | 70.0 18.8 11.2 | sandy | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| | 5.0 - 10.0 | 8.3 | 8.3 | 1.39 | 12.70 | 1.62 | 13.87 | 4.6 | 21.9 | 75.2 11.6 13.2 | sandy | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| | 10.0 - 15.0 | 8.0 | 8.1 | 0.99 | 10.15 | 2.51 | 4.52 | 5.4 | 19.9 | 86.6 7.6 5.8 | loamy sand | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| | 15.0 - 20.0 | 8.0 | 8.1 | 1.53 | 16.70 | 2.66 | 9.70 | 6.7 | 22.1 | 93.6 0.8 5.6 | sand | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| | 20.0 - 25.0 | 8.4 | 8.5 | 1.53 | 19.20 | 2.47 | 8.73 | 8.1 | 20.2 | 76.6 10.6 12.8 | sandy | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| | 25.0 - 30.0 | 8.4 | 8.4 | 1.00 | 14.15 | 0.76 | 5.04 | 8.3 | 28.1 | 70.0 14.6 15.4 | loam | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| | 30.0 - 35.0 | 8.5 | 8.5 | 1.47 | 19.05 | 2.28 | 6.79 | 8.9 | 20.9 | 81.4 9.0 9.6 | loamy sand | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| | 35.0 - 40.0 | 8.4 | 8.6 | 1.00 | 13.40 | 1.35 | 4.46 | 7.9 | 33.7 | 72.0 13.8 14.2 | sandy | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| | 0.0 - 40.0 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 5.6 | 22.0 | 0.39 | <0.02 | 0.51 | 0.009 | 2.9 | 1.9 | 1.2 | 0.3 | <0.1 | 0.2 | 0.3 | --- | --- | --- | --- | |
| | 40.0 - 45.8 | 8.6 | 8.7 | 0.93 | 14.45 | 1.94 | 2.91 | 9.2 | 33.3 | 53.2 28.0 18.8 | sandy loam | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 45.8 - 50.0 | 8.7 | 8.7 | 0.71 | 13.1 | 0.97 | 1.07 | 13.0 | 31.5 | 58.6 23.6 17.8 | sandy loam | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 50.0 - 55.75 | 8.7 | 8.7 | 0.97 | 17.4 | 1.20 | 2.68 | 12.5 | 43.1 | 33.2 37.6 29.2 | clay loam | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1234 | 55.75- 60.0 | 8.3 | 8.4 | 1.14 | 18.3 | 3.36 | 4.99 | 9.0 | 33.5 | 53.2 38.0 8.8 | sandy loam | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| | 60.0 - 64.3 | 8.3 | 8.3 | 1.41 | 24.4 | 0.77 | 5.04 | 14.3 | 28.4 | 45.4 33.8 20.8 | loam | 4.3 | 38.0 | 0.31 | <0.02 | 0.58 | <0.001 | 4.1 | 15.0 | 3.9 | 1.8 | <0.1 | 0.9 | 2.2 | --- | --- | --- | --- | --- | |
| | 64.3 - 66.6 | 8.1 | 8.2 | 0.83 | 16.3 | 0.48 | 1.94 | 14.9 | 49.8 | 16.6 37.4 46.0 | clay | 3.6 | 42.0 | 0.16 | <0.02 | 0.62 | <0.001 | 6.2 | 12.0 | 0.8 | 3.0 | 0.1 | 1.9 | 3.8 | --- | --- | --- | --- | --- | |
| | 66.6 - 68.5 | 7.7 | 7.9 | 1.36 | 24.0 | 1.07 | 2.81 | 17.2 | 48.1 | 38.0 21.8 40.2 | loam | 2.1 | 47.0 | 0.38 | <0.02 | 0.41 | <0.001 | 5.2 | 15.0 | 3.7 | 2.4 | <0.1 | 1.8 | 3.4 | --- | --- | --- | --- | --- | |
| | 74.0 - 78.2 | 7.8 | 7.9 | 1.02 | 22.0 | 0.02 | 0.68 | 37.2 | 30.4 | 34.8 43.6 16.6 | loam | 1.8 | 52.0 | 0.48 | <0.02 | 1.3 | <0.001 | 2.3 | 8.5 | 0.9 | 1.1 | <0.1 | 1.0 | 2.7 | --- | --- | --- | --- | --- | |
| | 78.2 - 81.0 | 7.6 | 8.0 | 1.57 | 28.2 | 1.90 | 2.24 | 19.6 | 41.4 | 53.8 26.8 19.4 | sandy loam | 3.7 | 43.0 | 0.21 | <0.02 | 0.64 | <0.001 | 4.1 | 22.0 | 5.3 | 1.9 | <0.1 | 1.1 | 3.6 | --- | --- | --- | --- | --- | |
| | 103.6 - 107.6 | 8.1 | 8.3 | 1.03 | 19.3 | 1.26 | 2.04 | 15.4 | 37.9 | 30.4 41.4 28.2 | loam | 3.9 | 41.0 | 0.23 | <0.02 | 0.43 | <0.001 | 7.4 | 13.0 | 6.1 | 2.0 | <0.1 | 2.4 | 1.6 | --- | --- | --- | --- | --- | |
| | 110.0 - 120.0 | 8.2 | 8.4 | 1.47 | 28.2 | 1.94 | 3.49 | 17.1 | 27.4 | 45.0 37.2 17.8 | loam | 4.1 | 38.0 | 0.21 | <0.02 | 0.45 | <0.001 | 3.7 | 26.0 | 6.1 | 1.9 | <0.1 | 2.1 | 1.7 | --- | --- | --- | --- | --- | |
| | 120.0 - 124.0 | 8.5 | 8.5 | 1.53 | 29.1 | 0.76 | 1.75 | 26.0 | 26.7 | 47.0 18.4 34.6 | clay | 4.0 | 34.0 | 0.22 | <0.02 | 0.42 | <0.001 | 1.5 | 29.0 | 4.6 | 1.0 | <0.1 | 1.5 | 0.7 | --- | --- | --- | --- | --- | |
| | 124.0 - 130.0 | 8.6 | 8.7 | 1.76 | 33.5 | 0.72 | 0.82 | 38.1 | 24.4 | 71.4 18.8 9.8 | sandy loam | 4.2 | 39.0 | 0.26 | <0.02 | 0.38 | <0.001 | 1.0 | 31.0 | 2.8 | 1.0 | <0.1 | 0.9 | 0.7 | --- | --- | --- | --- | --- | |
| | 130.0 - 140.0 | 8.8 | 8.9 | 1.55 | 31.0 | 0.38 | 0.97 | 37.9 | 20.9 | 34.2 43.8 22.0 | loam | 3.6 | 44.0 | 0.18 | <0.02 | 0.31 | <0.001 | 2.5 | 35.0 | 6.0 | 2.7 | <0.1 | 2.1 | 1.4 | --- | --- | --- | --- | --- | |
| | 140.0 - 141.5 | 7.8 | 8.3 | 2.94 | 60.0 | 1.71 | 1.94 | 44.4 | 27.4 | 38.2 39.8 22.0 | loam | 2.6 | 48.0 | 0.15 | 0.03 | 0.20 | <0.001 | 13.0 | 21.0 | 7.0 | 1.2 | <0.1 | 2.3 | 1.9 | --- | --- | --- | --- | --- | |
| 0.0 - 5.0 | 8.6 | 8.8 | 1.18 | 7.14 | 3.04 | 5.58 | 2.6 | 34.5 | 51.0 27.0 22.0 | sandy | 16.0 | 28.0 | 0.68 | <0.02 | 0.79 | 0.002 | 4.4 | 1.6 | 0.9 | 0.6 | <0.1 | 0.1 | 0.1 | --- | --- | --- | --- | --- | | |
| 5.0 - 15.0 | 7.8 | 7.8 | 3.01 | 25.3 | 4.25 | 10.22 | 9.5 | 26.9 | 69.2 15.8 15.0 | sandy loam | 12.0 | 26.0 | 0.51 | <0.02 | 0.76 | <0.001 | 0.4 | 2.0 | 0.4 | 0.3 | <0.1 | 0.3 | 0.2 | --- | --- | --- | --- | --- | | |
| 15.0 - 25.0 | 8.0 | 8.0 | 4.71 | 50.0 | 10.35 | 21.24 | 12.6 | 23.2 | 77.8 7.6 14.6 | loamy sand | 8.9 | 28.0 | 0.48 | <0.02 | 0.71 | <0.001 | 7.7 | 2.3 | 2.1 | 0.2 | <0.1 | 0.2 | 0.2 | --- | --- | --- | --- | --- | | |
| 25.0 - 30.0 | 8.1 | 8.1 | 1.96 | 10.5 | 6.34 | 9.70 | 3.7 | 25.1 | 58.4 25.2 16.4 | sandy loam | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |
| 25.0 - 35.0 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 6.7 | 30.0 | 0.53 | <0.02 | 0.68 | <0.001 | 5.3 | 3.3 | 3.6 | 0.3 | <0.1 | 0.4 | 0.2 | --- | --- | --- | --- | --- | |
| 35.0 - 40.0 | 8.2 | 8.2 | 4.15 | 28.7 | 21.56 | 24.92 | 6.6 | 22.9 | 54.0 39.0 7.0 | sandy loam | 5.3 | 27.0 | 0.36 | <0.02 | 0.63 | <0.001 | 1.3 | 2.8 | 3.2 | 0.4 | <0.1 | 0.4 | 0.1 | --- | --- | --- | --- | --- | | |
| 40.0 - 42.0 | 8.2 | 8.3 | 0.55 | 5.5 | 1.71 | 1.36 | 4.6 | 37.3 | 27.4 43.0 29.6 | clay loam | 2.9 | 24.0 | 0.14 | <0.02 | <0.1 | <0.001 | 0.6 | 7.1 | 4.8 | 1.0 | <0.1 | 1.0 | 0.2 | --- | --- | --- | --- | --- | | |

Table 8-1.--Analyses of overburden samples to determine suitability for plant growth, East Decker and North Extension areas.--Continued

| Core hole number | Depth below surface (feet) | pH | | Soluble salts (millimhos) | Sodium (meq/l) | Calcium (meq/l) | Mag- nesium (meq/l) | SAR | Satur- ation percent | Texture (percent) | | Equiv- alent soil class | Nitrogen | | Se (ppm) | Mo (ppm) | Hg (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Cd (ppm) | Pb (ppm) | Ni (ppm) | | |
|------------------|----------------------------|-------------------|----------------|---------------------------|----------------|-----------------|---------------------|------|----------------------|-------------------|------|-------------------------|---------------|-----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----|------|
| | | Satur- ated paste | 1:5 dilu- tion | | | | | | | sand | silt | | Nitrate (ppm) | Ammonia B (ppm) | | | | | | | | | | | | |
| 1234 (cont.) | 42.0 - 44.2 | 8.1 | 8.2 | 0.63 | 5.2 | 1.52 | 3.10 | 3.6 | 27.9 | 29.3 | 48.5 | 22.2 | loam | 2.7 | 27.0 | 0.24 | <0.02 | 0.52 | <0.001 | 1.8 | 31.0 | 31.0 | 1.7 | 0.2 | 0.7 | 0.3 |
| | 44.2 - 50.0 | 8.1 | 8.2 | 0.67 | 6.66 | 1.59 | 3.12 | 4.5 | 25.8 | 42.7 | 33.1 | 24.2 | loam | 2.8 | 29.0 | 0.26 | <0.02 | 0.13 | <0.001 | 0.3 | 9.0 | 8.2 | 0.4 | <0.1 | 0.4 | 0.2 |
| | 50.0 - 53.9 | 7.6 | 7.9 | 1.04 | 9.08 | 2.47 | 3.49 | 5.3 | 41.2 | 18.4 | 29.6 | 52.0 | clay | 2.6 | 31.0 | 0.23 | <0.02 | 0.54 | <0.001 | 3.9 | 21.0 | 11.0 | 0.9 | 0.4 | 3.1 | 1.7 |
| | 73.0 - 76.0 | 7.8 | 8.0 | 1.97 | 10.47 | 2.09 | 3.10 | 6.5 | 30.7 | 43.8 | 28.6 | 27.6 | loam | 2.4 | 32.0 | 0.25 | <0.02 | 0.56 | <0.001 | 2.6 | 17.0 | 1.9 | 0.6 | 0.2 | 1.2 | 0.8 |
| | 76.0 - 83.3 | 7.0 | 8.0 | 0.87 | 7.32 | 5.13 | 7.70 | 2.9 | 37.6 | 28.4 | 8.8 | 62.8 | clay | 2.1 | 34.0 | 0.26 | <0.02 | 0.58 | <0.001 | 2.4 | 13.0 | 1.6 | 1.0 | 0.4 | 1.9 | 2.6 |
| | 83.3 - 87.0 | 7.6 | 8.1 | 1.21 | 9.1 | 3.32 | 2.23 | 5.4 | 49.6 | 35.0 | 46.0 | 19.0 | loam | 2.2 | 38.0 | 0.25 | <0.02 | 0.64 | <0.001 | 1.3 | 26.0 | 2.2 | 0.9 | 0.4 | 1.0 | 1.6 |
| | 87.0 - 91.0 | 7.7 | 8.1 | 1.64 | 10.3 | 3.9 | 7.17 | 3.1 | 36.7 | 63.1 | 22.4 | 14.5 | loam | 2.0 | 40.0 | 0.24 | 0.04 | 0.72 | <0.001 | 1.5 | 19.0 | 1.9 | 0.5 | 0.2 | 0.6 | 1.2 |
| | 91.0 - 100.0 | 8.2 | 8.4 | 1.42 | 19.25 | 0.95 | 1.94 | 16.2 | 29.2 | 42.6 | 44.0 | 13.4 | loam | 2.1 | 37.0 | 0.27 | 0.05 | 0.69 | <0.001 | 1.9 | 17.0 | 0.9 | 0.5 | 0.2 | 0.5 | 0.8 |
| | 100.0 - 103.5 | 8.2 | 8.4 | 1.53 | 22.45 | 0.76 | 2.13 | 18.9 | 28.6 | 31.6 | 55.4 | 13.0 | loam | 2.2 | 41.0 | 0.19 | 0.07 | 0.31 | <0.001 | 0.7 | 16.0 | 0.6 | 0.4 | <0.1 | 0.4 | 0.9 |
| | 103.5 - 107.0 | 8.5 | 8.8 | 1.95 | 33.35 | 0.76 | 1.36 | 32.4 | 15.3 | 77.2 | 9.4 | 13.4 | loam | 2.1 | 56.0 | 0.11 | 0.09 | <0.10 | <0.001 | 0.4 | 65.0 | 1.3 | 0.4 | 0.1 | 0.2 | 0.4 |
| | 107.0 - 110.0 | 8.3 | 8.6 | 2.78 | 24.25 | 1.33 | 0.97 | 22.6 | 24.6 | 42.6 | 52.4 | 5.0 | loam | 2.3 | 58.0 | 0.28 | 0.08 | <0.10 | <0.001 | 1.3 | 26.0 | 1.1 | 2.1 | 0.3 | 0.4 | 1.3 |
| | 110.0 - 112.5 | 7.8 | 8.4 | 2.37 | 49.2 | 1.04 | 1.07 | 46.9 | 43.1 | 31.2 | 47.8 | 15.0 | loam | 2.0 | 57.0 | 0.31 | 0.07 | 0.32 | <0.001 | 1.1 | 25.0 | 1.7 | 0.8 | <0.1 | 0.2 | 1.4 |
| | 112.5 - 120.0 | 7.6 | 8.5 | 2.59 | 47.15 | 0.76 | 0.64 | 56.4 | 44.7 | 31.4 | 46.0 | 22.6 | loam | 1.9 | 59.0 | 0.33 | 0.08 | 0.41 | <0.001 | 1.6 | 23.0 | 2.7 | 0.9 | 0.2 | 0.4 | 1.7 |
| | 120.0 - 130.0 | 8.3 | 9.0 | 1.88 | 27.0 | 0.28 | 0.29 | 50.3 | 48.1 | 21.0 | 60.6 | 18.4 | loam | 2.0 | 54.0 | 0.30 | 0.09 | 0.47 | <0.001 | 1.9 | 28.0 | 2.9 | 0.8 | <0.1 | 1.3 | 3.5 |
| 130.0 - 140.0 | 7.8 | 8.3 | 1.68 | 30.6 | 0.38 | 0.19 | 57.8 | 44.8 | 25.4 | 47.2 | 27.4 | loam | 2.1 | 50.0 | 0.36 | 0.08 | 0.54 | <0.001 | 0.7 | 24.0 | 1.4 | 0.5 | <0.1 | 0.7 | 2.6 | |
| 1235 | 140.0 - 146.0 | 7.9 | 8.4 | 2.38 | 43.1 | 0.85 | 0.39 | 54.6 | 39.4 | 37.4 | 43.4 | 19.2 | loam | 1.9 | 46.0 | 0.52 | 0.07 | 0.81 | <0.001 | 0.8 | 26.0 | 2.0 | 0.5 | <0.1 | 0.4 | 1.6 |
| | 146.0 - 149.5 | 7.3 | 8.1 | 1.66 | 23.75 | 0.38 | 0.39 | 38.0 | 35.7 | 46.6 | 36.2 | 17.2 | loam | 2.0 | 40.0 | 1.1 | 0.08 | 0.77 | <0.001 | 0.7 | 8.9 | 0.3 | 0.3 | <0.1 | 0.4 | 1.0 |
| | 0.0 - 5.0 | 8.2 | 8.2 | 0.50 | 2.24 | 1.44 | 1.72 | 1.8 | 25.6 | 70.4 | 12.6 | 17.0 | loam | 4.7 | 32.0 | 0.28 | 0.09 | 0.99 | 0.012 | 2.6 | 1.4 | 1.0 | 0.3 | <0.1 | 0.2 | 0.3 |
| | 5.0 - 15.0 | 7.8 | 7.9 | 5.63 | 36.0 | 5.51 | 37.05 | 7.8 | 25.1 | 72.4 | 16.6 | 11.0 | loam | 4.5 | 34.0 | 0.31 | 0.08 | 1.1 | 0.003 | 0.5 | 0.9 | 0.4 | 0.1 | <0.1 | 0.4 | <0.1 |
| | 15.0 - 25.0 | 8.0 | 8.1 | 2.90 | 17.50 | 6.02 | 7.93 | 6.6 | 30.2 | 56.4 | 23.6 | 20.0 | loam | 4.3 | 31.0 | 0.34 | 0.07 | 0.86 | <0.001 | 1.0 | 1.1 | 3.0 | 0.3 | <0.1 | 0.2 | 0.1 |
| | 25.0 - 35.0 | 7.7 | 7.9 | 3.80 | 11.7 | 17.48 | 24.23 | 2.6 | 33.6 | 42.4 | 33.6 | 24.0 | loam | 4.1 | 36.0 | 0.32 | 0.04 | 0.89 | <0.001 | 4.2 | 2.3 | 1.3 | 0.5 | <0.1 | 0.3 | 0.6 |
| | 35.0 - 40.0 | 7.3 | 7.5 | 3.08 | 19.1 | 10.62 | 19.88 | 4.9 | 29.6 | 32.4 | 45.6 | 22.0 | loam | 2.3 | 34.0 | 0.47 | 0.03 | 0.32 | <0.001 | 4.0 | 2.9 | 1.4 | 0.5 | <0.1 | 0.5 | 0.3 |
| | 55.0 - 60.0 | 6.3 | 6.8 | 4.95 | 28.0 | 25.46 | 39.58 | 4.9 | 28.8 | 44.2 | 29.6 | 26.2 | loam | 2.7 | 32.0 | 0.62 | <0.02 | 0.21 | <0.001 | 2.8 | 37.0 | 15.0 | 2.2 | <0.1 | 0.7 | 1.2 |
| | 60.0 - 66.0 | 7.7 | 8.0 | 3.62 | 42.7 | 16.15 | 24.83 | 9.5 | 26.3 | 56.6 | 27.0 | 16.4 | loam | 3.1 | 37.0 | 0.65 | <0.02 | 0.20 | <0.001 | 4.1 | 19.0 | 5.3 | 0.8 | <0.1 | 2.2 | 2.0 |
| | 66.0 - 73.0 | 7.7 | 8.0 | 2.62 | 38.0 | 10.83 | 14.16 | 10.7 | 23.0 | 55.2 | 30.6 | 14.2 | loam | 2.9 | 38.0 | 0.76 | <0.02 | 0.15 | <0.001 | 1.5 | 15.0 | 3.6 | 0.4 | <0.1 | 1.0 | 1.4 |
| | 73.0 - 78.0 | 7.6 | 7.9 | 1.22 | 25.93 | 2.18 | 8.73 | 11.1 | 36.5 | 33.0 | 39.2 | 27.8 | loam | 3.0 | 42.0 | 0.81 | 0.02 | 0.13 | <0.001 | 3.3 | 18.0 | 2.5 | 0.8 | <0.1 | 3.3 | 1.9 |
| | 94.0 - 103.0 | 7.6 | 8.0 | 3.15 | 85.7 | 6.84 | 11.93 | 25.9 | 26.5 | 62.2 | 21.8 | 16.0 | loam | 2.1 | 39.0 | 1.2 | 0.03 | 0.21 | <0.001 | 1.8 | 15.0 | 1.6 | 0.4 | <0.1 | 0.7 | 1.5 |
| | 103.0 - 107.0 | 7.8 | 8.0 | 1.38 | 26.93 | 1.52 | 3.10 | 17.7 | 54.0 | 30.6 | 39.2 | 30.2 | loam | 2.0 | 36.0 | 1.1 | 0.03 | 0.11 | <0.001 | 3.7 | 24.0 | 1.7 | 1.8 | <0.1 | 0.8 | 2.6 |
| | 107.0 - 117.0 | 8.3 | 8.3 | 1.65 | 27.82 | 1.16 | 1.77 | 23.2 | 34.4 | 26.1 | 54.1 | 19.8 | loam | 3.2 | 49.0 | 0.72 | <0.02 | 0.13 | <0.001 | 4.6 | 15.0 | 0.9 | 0.9 | <0.1 | 0.4 | 1.7 |
| 117.0 - 126.0 | 8.6 | 8.6 | 1.62 | 21.20 | 0.76 | 1.84 | 23.0 | 31.5 | 31.8 | 52.8 | 15.4 | loam | 3.4 | 52.0 | 0.65 | <0.02 | 0.16 | <0.001 | 4.1 | 24.0 | 1.5 | 2.3 | <0.1 | 0.3 | 1.8 | |
| 126.0 - 130.0 | 7.6 | 8.1 | 2.25 | 36.75 | 0.47 | 0.68 | 48.7 | 52.2 | 37.0 | 39.2 | 23.8 | loam | 2.1 | 48.0 | 0.43 | 0.04 | 0.21 | <0.001 | 1.6 | 24.0 | 2.3 | 1.0 | <0.1 | 0.2 | 1.7 | |
| 130.0 - 137.0 | 8.4 | 8.5 | 1.59 | 16.50 | 0.38 | 0.10 | 33.7 | 48.1 | 30.4 | 37.8 | 31.8 | clay | 2.2 | 53.0 | 0.31 | 0.005 | 0.79 | <0.001 | 4.4 | 22.0 | 3.6 | 1.2 | <0.1 | 0.9 | 3.4 | |
| 137.0 - 147.0 | 8.3 | 8.5 | 1.44 | 13.0 | 0.19 | 0.19 | 29.9 | 47.9 | 15.6 | 44.0 | 40.4 | clay | 2.1 | 47.0 | 0.27 | 0.05 | 0.63 | <0.001 | 1.9 | 24.0 | 2.3 | 0.7 | <0.1 | 1.3 | 3.6 | |
| 147.0 - 157.0 | 8.2 | 8.2 | 1.28 | 15.26 | 0.09 | 0.10 | 48.3 | 46.3 | 22.4 | 40.2 | 37.4 | clay | 2.4 | 50.0 | 0.21 | 0.07 | 0.51 | <0.001 | 1.3 | 19.0 | 1.2 | 0.4 | <0.1 | 0.9 | 3.5 | |

Table B-1.--Analyses of overburden samples to determine suitability for plant growth, East Decker and North Extension areas.--Continued

| Core hole number | Depth below surface (feet) | pH | | Soluble Sodium salts (meq/l) | Calcium (meq/l) | Mag- nesium (meq/l) | SAR | Satur- ation percent | Texture (percent) | | Equiv- alent soil class | Nitrogen | | Mo (ppm) | Hg (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Cd (ppm) | Pb (ppm) | Ni (ppm) |
|---------------------|----------------------------------|-------------------------|---------------|------------------------------------|--------------------|---------------------------|-------|----------------------------|----------------------|------|----------------------------------|------------------|-----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | | Satur- ated paste | dilu- tion | | | | | | sand | silt | | Nitrate (ppm) | Ammonia B (ppm) | | | | | | | | | |
| 1236 | 0.0 - 5.0 | 8.2 | 8.2 | 4.8 | 39.0 | 3.54 | 16.3 | 20.9 | 81.0 | 12.8 | 6.2 sand | 4.2 | 26.0 | 0.24 | 0.06 | 0.011 | 0.8 | 2.0 | 0.8 | 0.2 | <0.1 | <0.1 |
| | 5.0 - 10.0 | 7.9 | 8.3 | 1.16 | 27.0 | 2.25 | 20.3 | 20.4 | 88.4 | 2.4 | 9.2 loamy sand | 4.1 | 24.0 | 0.26 | 0.06 | 0.002 | 0.1 | 1.9 | 1.1 | 0.3 | <0.1 | <0.1 |
| | 10.0 - 15.0 | 8.3 | 8.3 | 0.95 | 57.0 | 1.52 | 50.9 | 20.5 | 59.4 | 27.2 | 13.4 sandy loam | 3.9 | 22.0 | 0.22 | 0.06 | <0.001 | 0.3 | 1.9 | 1.7 | 0.3 | <0.1 | <0.1 |
| | 15.0 - 20.0 | 8.2 | 8.2 | 0.55 | 20.8 | 1.76 | 18.4 | 22.4 | 30.4 | 37.6 | 32.0 loam | 3.6 | 26.0 | 0.18 | 0.06 | <0.001 | 0.3 | 3.8 | 2.6 | 0.3 | <0.1 | <0.1 |
| | 40.0 - 47.0 | 8.1 | 8.1 | 1.67 | 14.46 | 5.28 | 7.7 | 26.5 | 46.8 | 39.2 | 14.0 loam | 3.4 | 28.0 | 0.21 | 0.06 | <0.001 | 1.6 | 6.5 | 7.6 | 0.1 | <0.1 | <0.1 |
| | 47.0 - 52.5 | 7.2 | 7.9 | 2.37 | 21.5 | 11.29 | 7.7 | 25.3 | 38.4 | 38.2 | 23.4 loam | 3.3 | 26.0 | 0.23 | 0.06 | <0.001 | 3.0 | 21.0 | 5.9 | 0.7 | <0.1 | 1.6 |
| | 73.0 - 75.0 | 7.0 | 7.6 | 2.41 | 20.6 | 3.99 | 7.9 | 42.9 | 23.2 | 58.4 | 18.4 loam | 2.3 | 22.0 | 0.22 | 0.06 | <0.001 | 3.3 | 20.0 | 3.2 | 0.5 | <0.1 | 1.6 |
| | 75.0 - 77.0 | 8.7 | 8.7 | 1.77 | 26.3 | 2.15 | 14.2 | 17.7 | 66.2 | 28.4 | 5.4 sandy loam | 2.5 | 24.0 | 0.13 | 0.06 | <0.001 | 2.4 | 125.0 | 5.3 | 0.5 | <0.1 | 0.9 |
| | 77.0 - 81.5 | 7.8 | 7.9 | 1.88 | 11.35 | 0.97 | 8.7 | 64.5 | 30.8 | 38.4 | 30.8 loam | 2.1 | 25.0 | 0.32 | 0.07 | <0.001 | 3.0 | 31.0 | 3.5 | 1.4 | <0.1 | 1.1 |
| | 81.5 - 83.5 | 8.0 | 8.1 | 1.43 | 9.83 | 1.43 | 6.5 | 30.2 | 28.8 | 52.0 | 19.2 silt | 2.4 | 26.0 | 0.19 | 0.06 | <0.001 | 2.0 | 25.0 | 1.3 | 0.7 | <0.1 | 0.3 |
| | 83.5 - 88.5 | 7.6 | 8.1 | 3.07 | 55.0 | 0.72 | 66.1 | 56.4 | 35.4 | 43.0 | 21.6 loam | 2.2 | 28.0 | 0.34 | 0.07 | <0.001 | 2.0 | 30.0 | 2.2 | 1.6 | <0.1 | 0.4 |
| | 88.5 - 98.5 | 7.2 | 7.9 | 1.22 | 12.23 | 6.46 | 4.1 | 43.0 | 51.0 | 32.4 | 16.6 loam | 2.1 | 30.0 | 0.21 | 0.06 | <0.001 | 1.6 | 29.0 | 3.7 | 0.5 | <0.1 | 0.6 |
| | 98.5 - 101.5 | 8.0 | 8.1 | 1.25 | 16.43 | 0.76 | 15.6 | 58.7 | 24.0 | 41.6 | 34.4 loam | 2.6 | 32.0 | 0.20 | 0.05 | <0.001 | 2.4 | 44.0 | 4.6 | 0.9 | <0.1 | 1.3 |
| | 101.5 - 111.5 | 8.0 | 8.1 | 1.26 | 16.99 | 0.38 | 30.1 | 48.2 | 18.6 | 39.4 | 42.0 clay | 2.1 | 36.0 | 0.29 | 0.06 | <0.001 | 1.7 | 28.0 | 2.3 | 0.9 | <0.1 | 1.7 |
| | 111.5 - 119.0 | 7.6 | 7.9 | 1.25 | 21.00 | 0.36 | 30.6 | 45.3 | 22.4 | 44.6 | 33.0 loam | 2.4 | 40.0 | 0.33 | 0.04 | <0.001 | 1.4 | 20.0 | 2.7 | 0.6 | <0.1 | 1.2 |
| 1237 | 0.0 - 5.0 | 8.3 | 8.4 | 1.30 | 7.46 | 1.50 | 2.81 | 36.1 | 65.2 | 21.6 | 13.2 loam | 24.0 | 26.0 | 0.59 | 0.08 | 0.001 | 1.0 | 2.1 | 2.2 | 0.6 | <0.1 | 0.1 |
| | 5.0 - 10.0 | 8.1 | 8.2 | 1.17 | 6.36 | 1.88 | 3.26 | 36.2 | 33.6 | 34.4 | 32.0 loam | 20.0 | 25.0 | 0.48 | 0.07 | 0.002 | 0.7 | 2.8 | 0.7 | 0.5 | <0.1 | 0.2 |
| | 10.0 - 20.0 | 8.0 | 8.0 | 6.57 | 54.6 | 25.02 | 9.90 | 44.6 | 42.4 | 29.6 | 28.0 loam | 18.0 | 24.0 | 0.32 | <0.02 | 0.009 | 0.7 | 2.1 | 0.5 | 0.9 | <0.1 | 0.5 |
| | 20.0 - 25.0 | 8.0 | 8.0 | 5.42 | 106.6 | 13.74 | 22.7 | 21.5 | 82.4 | 8.6 | 9.0 loamy sand | 14.0 | 23.0 | 0.21 | <0.02 | 0.021 | 14.0 | 1.4 | 1.2 | 0.3 | <0.1 | <0.1 |
| | 25.0 - 35.0 | 8.3 | 8.3 | 2.02 | 22.1 | 2.79 | 8.33 | 19.0 | 86.4 | 6.6 | 7.0 sand | 11.0 | 20.1 | 0.15 | <0.02 | 0.012 | 1.3 | 2.5 | 1.0 | 0.4 | <0.1 | <0.1 |
| | 35.0 - 45.0 | 8.3 | 8.4 | 2.00 | 20.4 | 3.28 | 8.92 | 21.7 | 66.4 | 15.6 | 18.0 loam | 8.2 | 19.0 | 0.14 | <0.02 | 0.003 | 2.2 | 6.9 | 3.0 | 0.5 | <0.1 | <0.1 |
| | 45.0 - 50.0 | 8.1 | 8.1 | 0.98 | 12.55 | 1.27 | 9.86 | 39.4 | 26.6 | 47.4 | 26.0 loam | 5.3 | 23.0 | 0.13 | <0.02 | <0.001 | 0.7 | 10.0 | 15.0 | 1.0 | <0.1 | 0.8 |
| | 50.0 - 60.0 | 8.1 | 8.1 | 1.74 | 20.45 | 2.18 | 11.51 | 42.4 | 34.6 | 46.8 | 18.6 loam | 2.4 | 25.0 | 0.12 | <0.02 | <0.001 | 1.6 | 35.0 | 7.7 | 0.7 | <0.1 | 1.6 |
| | 60.0 - 70.0 | 7.9 | 8.0 | 1.94 | 25.45 | 1.95 | 14.25 | 31.5 | 45.0 | 39.0 | 16.0 loam | 2.6 | 24.0 | 0.16 | <0.02 | <0.001 | 1.5 | 32.0 | 4.1 | 0.6 | <0.1 | 1.4 |
| | 70.0 - 72.0 | 7.8 | 7.8 | 1.23 | 16.70 | 0.58 | 16.43 | 45.8 | 19.2 | 42.4 | 38.4 silty clay | 2.1 | 37.0 | 0.33 | <0.02 | <0.001 | 4.8 | 8.7 | 0.6 | 0.8 | <0.1 | 4.2 |
| | 94.0 - 98.8 | 7.8 | 7.9 | 2.05 | 27.9 | 1.90 | 17.08 | 42.6 | 22.6 | 57.4 | 20.0 loam | 2.4 | 23.0 | 0.17 | <0.02 | <0.001 | 1.7 | 24.0 | 3.2 | 0.6 | <0.1 | 1.0 |
| | 98.8 - 105.3 | 8.1 | 8.2 | 1.88 | 32.2 | 0.40 | 40.3 | 44.7 | 29.4 | 41.2 | 29.4 loam | 2.3 | 39.0 | 0.36 | 0.03 | <0.001 | 1.7 | 31.0 | 3.3 | 1.2 | <0.1 | 0.9 |
| | 105.3 - 110.0 | 8.2 | 8.2 | 4.17 | 67.7 | 7.77 | 26.2 | 25.7 | 66.0 | 20.0 | 14.0 sandy loam | 3.3 | 36.0 | 0.08 | 0.04 | <0.001 | 1.1 | 21.0 | 2.8 | 0.5 | <0.1 | 0.6 |
| | 110.0 - 111.8 | 7.8 | 8.2 | 2.61 | 51.75 | 0.57 | 53.9 | 45.2 | 22.8 | 48.2 | 29.0 clay | 2.8 | 42.0 | 0.29 | 0.03 | <0.001 | 1.7 | 36.0 | 5.0 | 0.6 | <0.1 | 0.7 |
| | 111.8 - 120.0 | 8.3 | 8.4 | 3.05 | 56.3 | 1.17 | 54.1 | 19.0 | 56.8 | 29.2 | 14.0 loam | 2.7 | 36.0 | 0.12 | 0.02 | <0.001 | 1.1 | 21.0 | 1.8 | 0.3 | <0.1 | 0.6 |
| | 120.0 - 130.0 | 8.5 | 8.6 | 2.80 | 56.1 | 0.29 | 59.1 | 20.9 | 59.4 | 26.3 | 14.3 sandy loam | 2.3 | 31.0 | 0.14 | 0.03 | <0.001 | 1.2 | 34.0 | 2.3 | 0.3 | <0.1 | 0.4 |
| | 130.0 - 140.0 | 8.4 | 8.6 | 1.99 | 35.16 | 0.11 | 92.5 | 44.9 | 34.8 | 26.4 | 38.8 clay | 2.5 | 32.0 | 0.29 | 0.04 | <0.001 | 1.7 | 36.0 | 6.6 | 0.8 | <0.1 | 1.3 |
| | 140.0 - 150.0 | 8.3 | 8.4 | 1.43 | 30.18 | 0.06 | 77.4 | 45.8 | 28.4 | 36.7 | 34.9 loam | 2.6 | 38.0 | 0.26 | 0.06 | <0.001 | 1.4 | 27.0 | 2.8 | 0.5 | <0.1 | 1.0 |

Table B-1.--Analyses of overburden samples to determine suitability for plant growth, East Docket and North Extension areas.--Continued

| Core hole number | Depth below surface (feet) | pH | | Satur- ated paste | Soluble salts (millimhos) | Sodium (meq/l) | Calcium (meq/l) | Mag- nesium (meq/l) | SAR | Satur- ation percent | Texture (percent) | | | Equiv- alent soil class | Nitrate (ppm) | Nitrogen | | Mo (ppm) | Hg (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Cd (ppm) | Pb (ppm) | Ni (ppm) | |
|------------------|----------------------------|-------------------------|-----------------|-------------------------|---------------------------|----------------|-----------------|------------------------|------|----------------------------|-------------------|------|------|----------------------------------|---------------|---------------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| | | Satur- ated paste | 1.5 dilution | | | | | | | | sand | silt | clay | | | Ammonia (ppm) | B (ppm) | | | | | | | | | | Se (ppm) |
| 1238 | 79.0 - 84.0 | 8.1 | 2.1 | 1.28 | 17.6 | 0.95 | 1.76 | 15.1 | 29.0 | 64.8 | 25.6 | 9.6 | loam | sandy | 2.1 | 26.0 | 0.20 | 0.07 | -0.1 | 0.010 | 1.6 | 46.0 | 8.5 | 0.4 | <0.1 | 0.3 | 0.1 |
| | 84.0 - 88.0 | 8.0 | 8.1 | 1.55 | 10.50 | 3.07 | 6.46 | 4.8 | 28.3 | 34.8 | 51.6 | 13.6 | loam | silt | 2.3 | 29.0 | 0.26 | 0.06 | 0.26 | 0.003 | 2.0 | 18.0 | 5.4 | 0.7 | <0.1 | 1.2 | 1.1 |
| | 88.0 - 94.4 | 8.1 | 8.2 | 1.30 | 5.92 | 3.45 | 5.49 | 2.8 | 20.4 | 69.5 | 21.2 | 9.3 | loam | sandy | 1.9 | 23.0 | 0.24 | 0.07 | -0.1 | <0.001 | 0.6 | 21.0 | 5.4 | 0.6 | <0.1 | 0.1 | <0.1 |
| | 94.4 - 104.0 | 7.9 | 8.1 | 0.95 | 3.79 | 2.52 | 4.58 | 2.0 | 36.3 | 38.2 | 47.2 | 14.6 | loam | loam | 2.0 | 28.0 | 0.21 | 0.07 | 0.22 | <0.001 | 2.5 | 34.0 | 5.3 | 0.5 | <0.1 | 1.7 | 1.1 |
| | 104.0 - 109.0 | 7.8 | 8.1 | 1.09 | 2.80 | 3.43 | 5.04 | 1.4 | 34.4 | 37.8 | 59.0 | 3.2 | loam | silt | 2.1 | 29.0 | 0.19 | 0.08 | 0.23 | <0.001 | 2.6 | 50.0 | 7.4 | 1.0 | <0.1 | 2.7 | 1.0 |
| | 109.0 - 115.0 | 7.9 | 8.1 | 1.18 | 4.66 | 3.57 | 4.86 | 2.3 | 30.1 | 46.0 | 42.4 | 11.6 | loam | clay | 2.2 | 28.0 | 0.23 | 0.09 | 0.27 | <0.001 | 1.7 | 42.0 | 6.4 | 0.5 | <0.1 | 1.3 | 1.0 |
| | 115.0 - 119.0 | 7.4 | 7.9 | 1.26 | 3.03 | 3.89 | 6.63 | 1.3 | 38.1 | 32.2 | 39.8 | 28.0 | loam | clay | 2.1 | 32.0 | 0.25 | 0.08 | 0.61 | <0.001 | 4.3 | 33.0 | 5.5 | 1.1 | <0.1 | 3.7 | 2.3 |
| | 139.0 - 140.6 | 7.6 | 8.0 | 2.16 | 37.15 | 3.83 | 3.04 | 20.1 | 46.6 | 22.2 | 48.8 | 29.0 | loam | loam | 2.0 | 34.0 | 0.21 | 0.09 | 0.54 | <0.001 | 4.9 | 24.0 | 4.1 | 1.0 | <0.1 | 2.1 | 2.0 |
| | 140.6 - 144.6 | 8.1 | 8.2 | 2.24 | 43.7 | 1.99 | 1.94 | 31.4 | 64.2 | 37.6 | 44.8 | 17.6 | loam | loam | 2.2 | 36.0 | 0.25 | 0.09 | 0.62 | <0.001 | 1.9 | 26.0 | 3.5 | 0.5 | <0.1 | 1.2 | 0.9 |
| | 144.6 - 149.0 | 8.0 | 8.2 | 1.52 | 30.83 | 0.38 | 0.56 | 44.6 | 53.4 | 31.6 | 35.2 | 33.2 | loam | clay | 2.3 | 51.0 | 0.39 | 0.08 | 0.72 | <0.001 | 2.6 | 29.0 | 3.0 | 1.3 | <0.1 | 1.1 | 1.5 |
| | 149.0 - 153.0 | 7.9 | 8.1 | 1.48 | 32.33 | 0.60 | 0.19 | 51.5 | 50.0 | 35.6 | 37.0 | 27.4 | loam | clay | 1.9 | 54.0 | 0.41 | 0.08 | 0.63 | <0.001 | 1.8 | 28.0 | 2.4 | 1.2 | <0.1 | 0.4 | 1.2 |
| | 153.0 - 159.0 | 7.6 | 8.0 | 2.93 | 55.7 | 3.04 | 2.15 | 34.4 | 43.8 | 43.6 | 36.2 | 20.2 | loam | loam | 2.4 | 41.0 | 0.36 | 0.09 | 0.64 | <0.001 | 2.8 | 34.0 | 4.0 | 0.5 | <0.1 | 0.5 | 1.7 |
| | 159.0 - 169.0 | 8.6 | 8.6 | 2.83 | 66.83 | 0.35 | 0.67 | 94.1 | 20.3 | 55.6 | 31.6 | 12.8 | loam | sandy | 2.3 | 42.0 | 0.34 | 0.08 | 0.66 | <0.001 | 1.8 | 23.0 | 1.9 | 0.3 | <0.1 | 0.5 | 1.0 |
| | 169.0 - 179.0 | 8.8 | 8.8 | 1.86 | 37.25 | 0.10 | 0.18 | 100.7 | 46.7 | 22.2 | 39.3 | 39.5 | loam | clay | 2.2 | 45.0 | 0.37 | 0.09 | 0.69 | <0.001 | 2.7 | 37.0 | 5.7 | 0.9 | <0.1 | 1.1 | 1.5 |
| 179.0 - 185.0 | 8.1 | 8.2 | 1.47 | 29.5 | .090 | .030 | 120.4 | 42.8 | 19.9 | 42.8 | 37.3 | loam | clay | 5.3 | 41.0 | 0.41 | 0.09 | 0.64 | <0.001 | 1.4 | 26.0 | 1.8 | 0.8 | <0.1 | 1.3 | 1.8 | |
| 1255 | 185.0 - 192.5 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 8.1 | 36.0 | 0.49 | 0.09 | 0.59 | <0.001 | 3.0 | 28.0 | 1.7 | 1.1 | <0.1 | 1.3 | 5.6 | 6.6 |
| | 0.0 - 5.0 | 8.2 | 8.3 | 1.92 | 11.2 | 4.50 | 9.13 | 4.2 | 30.4 | 55.8 | 27.0 | 17.2 | loam | sandy | 12.0 | 26.0 | 0.45 | 0.08 | 0.66 | 0.002 | 1.3 | 1.3 | 0.8 | 0.3 | <0.1 | 0.1 | <0.1 |
| | 5.0 - 10.0 | 7.9 | 8.1 | 4.70 | 25.1 | 32.50 | 4.07 | 5.7 | 29.6 | 49.2 | 31.6 | 19.2 | loam | loam | 8.6 | 28.0 | 0.34 | 0.09 | 0.74 | <0.001 | 0.5 | 1.3 | 0.4 | 0.3 | <0.1 | 0.2 | <0.1 |
| | 10.0 - 15.0 | 7.9 | 8.0 | 5.01 | 20.0 | 29.33 | 14.89 | 4.2 | 28.8 | 53.0 | 27.6 | 19.4 | loam | sandy | 6.3 | 27.0 | 0.36 | 0.08 | 1.0 | <0.001 | 0.1 | 1.4 | 0.2 | 0.3 | <0.1 | 0.3 | <0.1 |
| | 15.0 - 20.0 | 8.0 | 8.1 | 4.50 | 17.5 | 27.64 | 23.93 | 9.8 | 25.2 | 65.0 | 22.8 | 12.2 | loam | sandy | 4.2 | 31.0 | 0.40 | 0.07 | 0.97 | <0.001 | 0.3 | 1.5 | 0.3 | 0.2 | <0.1 | 0.2 | <0.1 |
| | 20.0 - 30.0 | 8.1 | 8.2 | 3.21 | 5.4 | 25.93 | 11.19 | 1.0 | 17.1 | 90.6 | 4.0 | 5.4 | sand | loam | 3.9 | 30.0 | 0.43 | 0.06 | 0.76 | <0.001 | 0.3 | 3.4 | 1.0 | 0.2 | <0.1 | 0.3 | <0.1 |
| | 30.0 - 40.0 | 8.1 | 8.2 | 2.24 | 23.45 | 9.36 | 7.06 | 5.3 | 14.7 | 93.2 | 2.8 | 4.0 | sand | loam | 1.8 | 26.0 | 0.19 | 0.03 | 0.71 | <0.001 | 1.6 | 2.9 | 1.0 | 0.2 | <0.1 | 0.3 | <0.1 |
| | 40.0 - 50.0 | 8.2 | 8.2 | 2.21 | 11.58 | 6.68 | 6.59 | 4.0 | 16.0 | 93.8 | 2.0 | 4.2 | sand | loam | 1.6 | 28.0 | 0.23 | 0.03 | 0.73 | <0.001 | 1.1 | 2.5 | 1.0 | 0.2 | <0.1 | 0.4 | <0.1 |
| | 50.0 - 59.0 | 8.5 | 8.5 | 0.87 | 2.73 | 0.57 | 1.70 | 1.06 | 16.4 | 95.4 | 0.6 | 4.0 | sand | loam | 1.7 | 29.0 | 0.21 | 0.03 | 0.54 | <0.001 | 1.1 | 3.8 | 2.8 | 0.3 | <0.1 | 0.4 | <0.1 |
| | 65.0 - 75.0 | 7.5 | 8.0 | 1.35 | 11.57 | 1.65 | 2.67 | 11.1 | 31.1 | 38.6 | 41.8 | 19.6 | loam | loam | 3.9 | 28.0 | 0.08 | 0.08 | 0.24 | <0.001 | 1.8 | 23.0 | 23.0 | 0.5 | <0.1 | 2.2 | 1.6 |
| | 75.0 - 85.0 | 8.6 | 8.6 | 1.12 | 24.15 | 1.08 | 3.08 | 4.8 | 20.2 | 74.0 | 23.6 | 2.4 | loam | sandy | 3.8 | 26.0 | 0.12 | 0.07 | 0.21 | <0.001 | 3.1 | 60.0 | 12.0 | 0.8 | <0.1 | 1.3 | 1.4 |
| | 85.0 - 92.3 | 8.3 | 8.4 | 1.99 | 5.93 | 3.61 | 6.13 | 4.0 | 24.8 | 53.0 | 37.4 | 9.6 | loam | sandy | 4.1 | 31.0 | 0.14 | 0.07 | 0.20 | <0.001 | 1.0 | 13.0 | 6.0 | 0.6 | <0.1 | 1.0 | 1.4 |
| | 92.3 - 95.0 | 8.3 | 8.3 | 1.28 | 11.66 | 1.63 | 3.37 | 5.1 | 15.4 | 77.2 | 19.0 | 3.8 | loam | sandy | 3.9 | 27.0 | 0.19 | 0.08 | 0.19 | <0.001 | 1.5 | 140.0 | 2.8 | 0.3 | <0.1 | 0.7 | 0.9 |
| | 95.0 - 105.0 | 8.2 | 8.6 | 1.39 | 13.66 | 2.01 | 4.13 | 8.4 | 22.1 | 54.6 | 34.2 | 11.2 | loam | sandy | 4.2 | 30.0 | 0.18 | 0.08 | 0.21 | <0.001 | 1.6 | 21.0 | 3.8 | 0.6 | <0.1 | 1.0 | 1.2 |
| 105.0 - 108.2 | 8.2 | 8.2 | 1.21 | 11.13 | 1.42 | 3.72 | 6.4 | 38.0 | 34.6 | 43.0 | 22.4 | loam | loam | 4.0 | 31.0 | 0.20 | 0.07 | 0.25 | <0.001 | 6.2 | 43.0 | 5.9 | 1.6 | 0.1 | 2.4 | 2.9 | |
| 108.2 - 115.0 | 8.3 | 8.1 | 1.47 | 20.49 | 2.46 | 6.24 | 12.5 | 23.4 | 36.4 | 61.0 | 2.6 | loam | silt | 3.6 | 33.0 | 0.18 | 0.08 | 0.31 | <0.001 | 2.0 | 23.0 | 3.2 | 0.3 | <0.1 | 0.5 | 0.4 | |
| 115.0 - 120.0 | 8.3 | 8.3 | 1.69 | 52.0 | 1.02 | 2.30 | 24.2 | 33.3 | 34.8 | 41.4 | 23.8 | loam | loam | 2.1 | 52.0 | 0.17 | 0.09 | 0.36 | <0.001 | 6.5 | 25.0 | 3.1 | 2.1 | <0.1 | 3.1 | 1.3 | |
| 135.0 - 138.0 | 7.0 | 8.0 | 3.55 | 66.7 | 2.96 | 3.18 | 50.7 | 36.1 | 47.4 | 26.8 | 27.8 | loam | clay | 3.1 | 63.0 | 0.19 | 0.12 | 0.42 | <0.001 | 3.7 | 23.0 | 2.3 | 0.7 | 0.1 | 1.3 | 2.4 | |

Table B-1.--Analyses of overburden samples to determine suitability for plant growth, East Decker and North Extension areas.--Continued

| Core hole number | Depth below surface (feet) | pH | | Soluble salts (millimhos) | Sodium (meq/l) | Calcium (meq/l) | Magnesium (meq/l) | SAR | Saturation percent | Texture (percent) | | Equivalent soil class | Nitrogen | | B (ppm) | Se (ppm) | Ito (ppm) | Hg (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Cd (ppm) | Pb (ppm) | Ni (ppm) |
|------------------|----------------------------|-----------------|--------------|---------------------------|----------------|-----------------|-------------------|-------|--------------------|-------------------|------|-----------------------|---------------|---------------|---------|----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|
| | | Saturated paste | 1:5 dilution | | | | | | | Sand | Silt | | Nitrate (ppm) | Ammonia (ppm) | | | | | | | | | | | |
| 1256 | 0.0 - 5.0 | 7.5 | 8.0 | 0.83 | 5.26 | 1.72 | 2.35 | 3.7 | 16.8 | 44.4 | 48.8 | 6.8 loam | 12.0 | 24.0 | 0.26 | 0.08 | 0.57 | 0.009 | 1.0 | <1.1 | 0.5 | 0.5 | <0.1 | <0.1 | <0.1 |
| | 5.0 - 10.0 | 8.3 | 8.3 | 4.37 | 21.26 | 7.22 | 16.40 | 5.2 | 32.2 | 70.4 | 21.6 | 8.0 loam | 9.2 | 25.0 | 0.24 | 0.07 | 0.46 | 0.002 | 1.3 | <1.9 | 0.5 | 0.6 | <0.1 | 0.2 | <0.1 |
| | 10.0 - 15.0 | 8.6 | 8.6 | 6.70 | 31.4 | 12.58 | 17.2 | 7.2 | 17.6 | 50.4 | 39.6 | 10.9 loam | 13.0 | 24.0 | 0.25 | 0.07 | 0.61 | <0.001 | 1.9 | 2.0 | 0.6 | 0.4 | <0.1 | <0.1 | <0.1 |
| | 15.0 - 17.0 | 7.1 | 7.3 | 6.04 | 30.9 | 9.54 | 26.72 | 7.2 | 17.5 | 76.4 | 11.6 | 12.0 loam | 21.0 | 36.0 | 0.31 | 0.08 | 0.32 | <0.001 | 1.9 | 27.0 | 1.0 | 0.3 | <0.1 | <0.1 | <0.1 |
| | 17.0 - 20.0 | 6.0 | 6.2 | 7.10 | 42.5 | 9.72 | 22.98 | 10.5 | 26.5 | 90.4 | 5.6 | 4.0 sand | 56.0 | 39.0 | 0.34 | 0.09 | 0.30 | <0.001 | 6.1 | 100.0 | 5.9 | 0.7 | <0.1 | <0.1 | 0.4 |
| | 20.0 - 25.0 | 7.0 | 7.1 | 7.42 | 44.0 | 10.48 | 18.12 | 8.2 | 23.3 | 90.4 | 5.6 | 4.0 sand | 42.0 | 36.0 | 0.32 | 0.07 | 0.36 | <0.001 | 9.7 | 76.0 | 1.7 | 0.8 | <0.1 | 0.1 | <0.1 |
| | 25.0 - 30.0 | 7.1 | 7.5 | 5.50 | 27.3 | 8.71 | 19.13 | 7.3 | 24.4 | 74.4 | 11.6 | 14.0 loam | 34.0 | 22.0 | 0.48 | 0.06 | 0.13 | <0.001 | 4.3 | 35.0 | 2.3 | 0.9 | <0.1 | 0.4 | 0.4 |
| | 30.0 - 32.0 | 7.5 | 7.7 | 6.10 | 31.0 | 8.75 | 22.17 | 7.9 | 23.3 | 56.4 | 31.6 | 12.0 loam | 12.0 | 23.0 | 0.41 | 0.07 | 0.15 | <0.001 | 3.9 | 26.0 | 4.1 | 1.2 | <0.1 | 0.5 | 1.0 |
| | 32.0 - 42.0 | 7.8 | 8.0 | 3.79 | 27.8 | 7.79 | 38.85 | 5.6 | 24.4 | 45.2 | 54.4 | 0.4 loam | 4.2 | 24.0 | 0.21 | 0.08 | 0.64 | <0.001 | 3.1 | 22.0 | 2.9 | 1.2 | <0.1 | 1.5 | 1.8 |
| | 42.0 - 52.0 | 8.0 | 8.1 | 1.95 | 15.5 | 2.68 | 13.77 | 5.3 | 26.5 | 37.6 | 60.0 | 2.4 loam | 3.1 | 26.0 | 0.12 | 0.09 | 0.68 | <0.001 | 3.9 | 24.0 | 4.1 | 0.8 | <0.1 | 1.9 | 2.0 |
| | 52.0 - 62.0 | 8.3 | 8.3 | 1.76 | 18.6 | 2.56 | 9.40 | 7.5 | 19.4 | 87.6 | 10.0 | 2.4 sand | 2.6 | 34.0 | 0.28 | 0.08 | 0.39 | <0.001 | 5.2 | 25.0 | 5.3 | 1.6 | <0.1 | 0.8 | 0.7 |
| | 62.0 - 72.0 | 8.4 | 8.4 | 1.75 | 14.65 | 0.43 | 0.77 | 18.3 | 21.5 | 67.6 | 22.0 | 10.4 loam | 2.4 | 25.0 | 0.13 | 0.06 | 0.71 | <0.001 | 2.8 | 16.0 | 2.3 | 0.8 | <0.1 | 0.8 | 1.5 |
| | 72.0 - 82.0 | 8.2 | 8.3 | 1.91 | 29.5 | 1.78 | 3.12 | 18.6 | 18.2 | 61.6 | 28.0 | 10.4 loam | 2.5 | 27.0 | 0.16 | 0.07 | 0.65 | <0.001 | 4.0 | 11.0 | 3.1 | 0.7 | <0.1 | 0.7 | 0.6 |
| | 101.0 - 103.0 | 7.7 | 7.9 | 2.39 | 53.3 | 3.74 | 3.82 | 27.1 | 38.2 | 25.6 | 46.0 | 28.4 loam | 2.7 | 32.0 | 0.11 | 0.08 | 0.36 | <0.001 | 8.1 | 24.0 | 3.9 | 1.4 | <0.1 | 0.7 | 2.1 |
| | 103.0 - 105.0 | 8.0 | 8.2 | 2.48 | 38.15 | 4.69 | 2.67 | 19.4 | 18.6 | 73.2 | 20.4 | 6.4 loam | 2.6 | 20.0 | 0.03 | 0.09 | 1.2 | <0.001 | 1.2 | 27.0 | 1.4 | 0.4 | <0.1 | 0.2 | 1.2 |
| | 105.0 - 109.0 | 8.5 | 8.8 | 1.67 | 25.6 | 0.26 | 0.25 | 49.2 | 49.5 | 25.6 | 42.0 | 32.4 loam | 2.3 | 38.0 | 0.12 | 0.07 | 0.72 | <0.001 | 5.4 | 33.0 | 2.0 | 2.4 | <0.1 | 0.7 | 2.2 |
| | 109.0 - 112.0 | 8.5 | 8.6 | 2.25 | 43.3 | 0.15 | 0.05 | 58.6 | 24.2 | 17.6 | 60.0 | 22.4 loam | 2.4 | 22.0 | 0.13 | 0.09 | 1.1 | <0.001 | 7.7 | 22.0 | 1.9 | 1.4 | <0.1 | 0.3 | 1.2 |
| | 112.0 - 122.0 | 8.6 | 8.7 | 1.81 | 34.15 | 0.39 | 0.44 | 51.4 | 25.5 | 29.2 | 52.4 | 18.4 loam | 2.1 | 24.0 | 0.15 | 0.08 | 1.0 | <0.001 | 4.6 | 26.0 | 1.0 | 1.3 | <0.1 | 0.3 | 1.2 |
| | 122.0 - 125.0 | 8.8 | 8.9 | 2.33 | 41.0 | 0.49 | 0.56 | 55.3 | 22.2 | 51.2 | 34.4 | 14.4 loam | 2.7 | 23.0 | 0.14 | 0.07 | 1.2 | <0.001 | 8.8 | 51.0 | 2.2 | 4.3 | <0.1 | 0.2 | 1.7 |
| | 125.0 - 131.0 | 7.9 | 8.4 | 2.30 | 43.0 | 0.76 | 0.75 | 48.3 | 45.3 | 31.2 | 44.4 | 24.4 loam | 2.5 | 45.0 | 0.48 | 0.08 | 0.84 | <0.001 | 6.1 | 34.0 | 2.3 | 2.6 | <0.1 | 0.1 | 2.4 |
| | 138.0 - 142.0 | 8.6 | 8.8 | 1.49 | 30.0 | 0.49 | 0.09 | 54.0 | 51.3 | 21.2 | 39.6 | 39.2 loam | 2.6 | 47.0 | 0.32 | 0.07 | 0.62 | <0.001 | 8.6 | 35.0 | 4.4 | 2.4 | <0.1 | 1.6 | 5.3 |
| | 142.0 - 151.0 | 8.0 | 8.7 | 1.28 | 25.5 | 0.49 | 0.44 | 40.2 | 49.6 | 18.8 | 50.0 | 31.2 loam | 2.3 | 51.0 | 0.64 | 0.08 | 0.67 | <0.001 | 3.9 | 31.0 | 1.7 | 1.3 | <0.1 | 1.0 | 4.1 |
| | 151.0 - 154.0 | 8.0 | 8.5 | 1.70 | 31.7 | 0.22 | 0.58 | 46.3 | 38.6 | 30.8 | 46.0 | 23.2 loam | 2.5 | 48.0 | 0.69 | 0.08 | 0.69 | <0.001 | 4.7 | 26.0 | 2.8 | 1.3 | <0.1 | 0.5 | 3.2 |
| 1257 | 156.0 - 158.0 | 7.9 | 7.9 | 1.02 | 21.5 | 0.38 | 0.01 | 47.0 | 40.3 | 50.8 | 28.0 | 21.2 loam | 2.4 | 50.0 | 0.73 | 0.09 | 0.62 | <0.001 | 2.1 | 16.0 | 0.4 | 1.1 | <0.1 | 0.6 | 1.0 |
| | 0.0 - 5.0 | 7.8 | 7.9 | 6.50 | 70.2 | 18.77 | 35.56 | 13.47 | 29.0 | 55.6 | 42.0 | 2.4 loam | 5.8 | 14.0 | 0.29 | 0.08 | 0.42 | 0.011 | 40.0 | 3.6 | 5.0 | 0.6 | <0.1 | 0.3 | 0.4 |
| | 5.0 - 15.0 | 8.1 | 8.1 | 6.00 | 73.3 | 15.67 | 40.54 | 13.85 | 29.8 | 30.4 | 66.8 | 2.8 loam | 3.6 | 16.0 | 0.25 | 0.07 | 0.32 | 0.023 | 1.7 | 2.9 | 2.2 | 0.3 | <0.1 | 0.5 | <0.1 |
| | 15.0 - 20.0 | 8.3 | 8.3 | 3.11 | 51.8 | 2.47 | 12.70 | 11.13 | 26.8 | 50.0 | 35.2 | 14.8 loam | 2.7 | 19.0 | 0.27 | 0.06 | 0.31 | 0.019 | 1.1 | 2.9 | 2.5 | 0.4 | <0.1 | 0.6 | 0.1 |
| | 20.0 - 22.4 | 8.6 | 8.7 | 1.24 | 12.0 | 1.29 | 4.20 | 7.10 | 15.0 | 83.2 | 15.6 | 1.2 sand | 2.9 | 17.0 | 0.14 | 0.08 | 0.30 | 0.008 | 1.4 | 150.0 | 10.0 | 0.2 | <0.1 | 0.2 | 0.7 |
| | 22.4 - 24.6 | 8.0 | 8.1 | 2.07 | 23.6 | 2.48 | 8.57 | 9.83 | 22.8 | 45.2 | 43.6 | 11.2 sand | 2.1 | 19.0 | 0.26 | 0.07 | 0.34 | 0.011 | 1.2 | 28.0 | 6.5 | 0.6 | <0.1 | 0.8 | <0.1 |
| | 24.6 - 26.0 | 8.7 | 8.8 | 1.31 | 12.1 | 1.14 | 4.07 | 7.3 | 15.8 | 75.6 | 21.2 | 3.2 loam | 2.3 | 18.0 | 0.19 | 0.07 | 0.42 | 0.006 | 1.6 | 200.0 | 5.9 | 0.6 | <0.1 | 0.2 | 0.7 |
| | 26.0 - 36.0 | 8.0 | 8.1 | 2.13 | 14.5 | 2.77 | 12.20 | 5.2 | 20.7 | 49.6 | 39.2 | 11.2 loam | 2.4 | 16.0 | 0.27 | 0.06 | 0.40 | 0.022 | 2.1 | 48.0 | 7.4 | 1.0 | <0.1 | 1.1 | 0.6 |
| | 36.0 - 41.0 | 8.3 | 8.4 | 1.26 | 10.0 | 1.50 | 5.66 | 5.2 | 20.6 | 69.6 | 22.8 | 7.6 loam | 2.1 | 18.0 | 0.21 | 0.07 | 0.44 | 0.024 | 0.6 | 16.0 | 5.9 | 0.3 | <0.1 | 0.4 | 0.1 |
| | 41.0 - 48.0 | 8.2 | 8.4 | 1.46 | 11.9 | 2.22 | 5.14 | 6.1 | 21.1 | 75.6 | 14.8 | 9.6 loam | 2.0 | 19.0 | 0.19 | 0.06 | 0.32 | 0.022 | 1.0 | 6.0 | 5.9 | 0.5 | <0.1 | 0.3 | 0.1 |
| | 48.0 - 53.5 | 8.5 | 8.7 | 2.60 | 21.8 | 5.87 | 12.88 | 7.0 | 19.0 | 75.6 | 17.7 | 7.2 loam | 1.9 | 22.0 | 0.03 | 0.06 | 0.26 | 0.013 | 1.7 | 6.1 | 1.7 | 0.5 | <0.1 | 0.7 | 0.2 |
| | 71.0 - 76.5 | 8.5 | 8.7 | 1.30 | 12.7 | 2.18 | 3.10 | 7.7 | 44.4 | 31.6 | 38.8 | 29.6 loam | 2.1 | 21.0 | 0.11 | 0.06 | 0.25 | 0.006 | 5.0 | 26.0 | 1.3 | 1.7 | <0.1 | 2.3 | 2.7 |

Table B-1.--Analyses of overburden samples to determine suitability for plant growth, East Decker and North Extension areas.--Continued

| Core hole number | Depth below surface (feet) | pH | | Soluble salts (millimhos) | Sodium (meq/l) | Calcium (meq/l) | Mag-nesium (meq/l) | SAR | Satur-ation percent | Texture (percent) | | | Equi-valent soil class | Nitrogen | | Se (ppm) | Mo (ppm) | Hg (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Cd (ppm) | Pb (ppm) | Ni (ppm) | |
|------------------|----------------------------|------------------|---------------|---------------------------|----------------|-----------------|--------------------|------|---------------------|-------------------|------|------------|------------------------|---------------|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| | | Satur-ated paste | 1:5 dilu-tion | | | | | | | Sand | Silt | Clay | | Nitrate (ppm) | Ammonia (ppm) | | | | | | | | | | | |
| 1257 (cont.) | 76.5 - 81.0 | 8.0 | 8.2 | 1.65 | 18.5 | 1.97 | 2.98 | 11.5 | 40.2 | 39.6 | 38.8 | 21.6 | loam | 1.8 | 22.0 | 0.09 | 0.06 | 0.23 | 0.002 | 2.6 | 34.0 | 4.6 | 0.8 | <0.1 | 1.0 | 2.7 |
| | 81.0 - 83.0 | 8.2 | 8.2 | 1.45 | 20.8 | 1.10 | 1.62 | 17.4 | 41.1 | 39.6 | 38.8 | 21.6 | loam | 1.9 | 24.0 | 0.06 | 0.07 | 0.25 | <0.001 | 1.7 | 50.0 | 5.3 | 0.4 | <0.1 | 1.0 | 1.7 |
| | 83.0 - 91.0 | 8.0 | 8.2 | 1.68 | 28.5 | 0.81 | 1.10 | 28.5 | 37.9 | 27.6 | 50.8 | 21.6 | loam | 2.0 | 22.0 | 0.05 | 0.07 | 0.26 | <0.001 | 2.1 | 24.0 | 1.7 | 0.9 | <0.1 | 0.6 | 1.7 |
| | 91.0 - 101.0 | 8.4 | 8.4 | 2.01 | 33.95 | 0.43 | 1.16 | 37.3 | 26.8 | 41.6 | 46.8 | 11.6 | loam sandy | 2.1 | 23.0 | 0.08 | 0.06 | 0.20 | <0.001 | 1.4 | 22.0 | 1.1 | 0.7 | <0.1 | 0.3 | 0.8 |
| | 101.0 - 103.0 | 8.2 | 8.4 | 2.64 | 47.0 | 1.21 | 1.57 | 39.0 | 20.3 | 66.8 | 24.8 | 8.4 | loam silt | 2.0 | 21.0 | 0.12 | 0.05 | 0.24 | <0.001 | 1.4 | 88.0 | 1.8 | 0.8 | <0.1 | 0.1 | 1.0 |
| | 103.0 - 108.0 | 7.7 | 8.0 | 2.00 | 36.5 | 0.62 | 0.89 | 41.1 | 35.7 | 30.8 | 54.8 | 14.4 | loam | 2.1 | 24.0 | 0.11 | 0.05 | 0.22 | <0.001 | 2.0 | 24.0 | 1.5 | 0.9 | <0.1 | 0.2 | 1.6 |
| | 108.0 - 118.0 | 7.8 | 8.3 | 2.17 | 38.0 | 0.76 | 0.91 | 40.7 | 51.7 | 27.2 | 44.4 | 28.4 | loam clay | 1.9 | 38.0 | 0.29 | 0.04 | 0.47 | <0.001 | 2.4 | 31.0 | 3.6 | 1.0 | <0.1 | 0.7 | 2.0 |
| | 118.0 - 128.0 | 8.0 | 8.2 | 1.89 | 25.6 | 0.34 | 0.46 | 39.4 | 43.9 | 16.8 | 50.8 | 32.4 | loam clay | 2.3 | 39.0 | 0.36 | 0.05 | 0.54 | <0.001 | 1.8 | 27.0 | 2.0 | 0.7 | <0.1 | 0.8 | 2.5 |
| | 128.0 - 138.0 | 7.8 | 8.2 | 1.95 | 41.0 | 0.39 | 0.56 | 58.0 | 35.8 | 29.6 | 49.6 | 20.8 | loam | 2.6 | 37.0 | 0.47 | 0.06 | 0.59 | <0.001 | 1.7 | 21.0 | 1.8 | 0.6 | <0.1 | 0.4 | 2.3 |
| | 138.0 - 141.0 | 7.5 | 7.9 | 1.82 | 35.5 | 0.53 | 0.11 | 60.9 | 36.5 | 43.2 | 34.0 | 22.8 | loam sandy | 2.9 | 50.0 | 0.91 | 0.06 | 0.81 | <0.001 | 1.4 | 11.0 | 0.8 | 0.6 | <0.1 | 0.4 | 1.5 |
| 1258 | 0.0 - 5.0 | 8.1 | 8.2 | 0.94 | 8.26 | 1.44 | 3.47 | 5.2 | 24.7 | 55.2 | 29.2 | 15.6 | loam sandy | 7.6 | 18.0 | 0.32 | 0.06 | 0.46 | 3.010 | 4.1 | 2.4 | 1.0 | 0.5 | 0.1 | <0.1 | <0.1 |
| | 5.0 - 10.0 | 8.2 | 8.3 | 1.67 | 15.43 | 4.94 | 5.52 | 6.9 | 16.7 | 71.2 | 15.2 | 13.6 | loam sandy | 7.1 | 20.0 | 0.36 | 0.05 | 0.52 | 0.003 | 1.4 | 1.3 | 0.3 | 0.4 | <0.1 | <0.1 | <0.1 |
| | 10.0 - 15.0 | 8.1 | 8.3 | 1.59 | 12.43 | 2.69 | 6.22 | 5.6 | 23.9 | 88.4 | 3.8 | 7.6 | loamy | 6.9 | 19.0 | 0.31 | 0.06 | 0.49 | <0.001 | 1.9 | 2.7 | 0.3 | 0.8 | <0.1 | <0.1 | <0.1 |
| | 15.0 - 20.0 | 7.8 | 8.0 | 1.71 | 12.90 | 2.66 | 8.71 | 5.3 | 21.4 | 84.4 | 8.0 | 7.6 | loamy | 6.4 | 22.0 | 0.29 | 0.05 | 0.55 | <0.001 | 1.2 | 2.3 | 0.3 | 0.5 | <0.1 | <0.1 | <0.1 |
| | 20.0 - 30.0 | 7.9 | 8.1 | 1.81 | 12.63 | 4.59 | 7.77 | 4.9 | 17.6 | 85.2 | 5.2 | 9.6 | sand loamy | 6.2 | 21.0 | 0.27 | 0.05 | 0.47 | <0.001 | 2.0 | 2.1 | 1.3 | 0.5 | <0.1 | <0.1 | <0.1 |
| | 30.0 - 35.0 | 8.0 | 8.1 | 1.90 | 13.65 | 5.16 | 7.62 | 5.3 | 18.8 | 91.2 | 2.0 | 6.8 | sands | 5.4 | 23.0 | 0.29 | 0.06 | 0.43 | <0.001 | 1.1 | 2.2 | 1.2 | 0.7 | <0.1 | <0.1 | <0.1 |
| | 35.0 - 63.0 | 7.6 | 7.8 | 1.18 | 15.36 | 2.12 | 1.22 | 11.6 | 19.0 | 95.2 | 0.0 | 4.8 | sands | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| | 80.0 - 82.0 | 6.9 | 7.5 | 2.29 | 19.15 | 8.18 | 14.91 | 5.5 | 54.7 | 53.2 | 31.2 | 15.6 | loam sandy | 2.9 | 40.0 | 0.63 | 0.06 | 0.40 | <0.001 | 2.1 | 29.0 | 5.4 | 1.0 | <0.1 | 0.3 | 1.6 |
| | 82.0 - 90.0 | 7.2 | 7.9 | 2.93 | 20.1 | 1.67 | 2.39 | 5.8 | 32.6 | 57.2 | 27.2 | 15.6 | loams | 2.1 | 26.0 | 0.29 | 0.07 | 0.45 | <0.001 | 1.6 | 30.0 | 3.8 | 0.5 | <0.1 | 0.7 | 2.4 |
| | 90.0 - 94.5 | 7.7 | 8.1 | 2.67 | 42.1 | 0.66 | 1.14 | 1.9 | 44.2 | 25.2 | 41.2 | 33.6 | loam clay | 2.6 | 27.0 | 0.21 | 0.07 | 0.52 | <0.001 | 1.9 | 23.0 | 3.5 | 0.7 | <0.1 | 0.8 | 1.7 |
| 1263 | 94.5 - 100.0 | 7.9 | 8.1 | 1.63 | 28.5 | 0.24 | 0.09 | 30.0 | 49.7 | 31.2 | 39.2 | 29.6 | loam clay | 2.4 | 34.0 | 0.37 | 0.06 | 0.61 | <0.001 | 2.6 | 27.0 | 4.1 | 0.9 | <0.1 | 0.8 | 2.0 |
| | 100.0 - 110.0 | 7.9 | 8.1 | 1.23 | 24.43 | 5.89 | 6.40 | 9.6 | 46.8 | 29.2 | 41.6 | 29.2 | loam clay | 2.9 | 37.0 | 0.35 | 0.06 | 0.43 | <0.001 | 1.8 | 21.0 | 1.6 | 0.7 | <0.1 | 1.0 | 2.3 |
| | 110.0 - 114.8 | 7.5 | 7.8 | 1.47 | 17.93 | 0.81 | 1.72 | 15.6 | 47.1 | 51.2 | 31.6 | 17.2 | loam | 2.5 | 36.0 | 0.30 | 0.07 | 0.31 | <0.001 | 1.7 | 22.0 | 1.7 | 0.5 | <0.1 | 0.7 | 1.8 |
| | 0.0 - 5.0 | 7.7 | 8.0 | 5.60 | 14.47 | 35.15 | 28.11 | 2.5 | 39.2 | 36.0 | 47.2 | 16.8 | loam | 120.0 | 32.0 | 0.04 | 0.10 | <0.1 | 0.001 | 0.5 | 3.1 | 0.9 | 0.9 | <0.1 | 0.4 | 0.2 |
| | 5.0 - 10.0 | 7.8 | 8.0 | 3.95 | 18.6 | 22.0 | 21.1 | 6.8 | 34.7 | 40.0 | 37.2 | 22.8 | loam sandy | 90.0 | 28.0 | 0.11 | 0.11 | <0.1 | 0.002 | 0.7 | 4.2 | 1.1 | 1.2 | <0.1 | 0.3 | <0.1 |
| | 10.0 - 15.0 | 8.1 | 8.7 | 2.51 | 20.0 | 6.3 | 9.7 | 6.9 | 24.9 | 72.0 | 14.8 | 13.2 | loam | 32.0 | 24.0 | 0.19 | 0.08 | 0.21 | 0.004 | 0.9 | 3.1 | 1.8 | 1.1 | <0.1 | 0.3 | <0.1 |
| | 15.0 - 25.0 | 8.3 | 8.3 | 1.83 | 19.0 | 4.27 | 3.78 | 9.3 | 20.5 | 82.0 | 8.2 | 9.8 | loamy sand | 24.0 | 22.0 | 0.26 | 0.09 | 0.26 | 0.010 | 0.5 | 2.8 | 2.2 | 1.0 | <0.1 | 0.2 | <0.1 |
| | 25.0 - 32.0 | 8.0 | 8.2 | 2.01 | 18.0 | 5.89 | 5.43 | 7.4 | 22.1 | 77.6 | 8.0 | 16.4 | loam sandy | 16.0 | 23.0 | 0.25 | 0.09 | 0.23 | 0.004 | 1.0 | 3.6 | 1.8 | 1.5 | <0.1 | 0.2 | <0.1 |
| | 32.0 - 42.0 | 8.1 | 8.2 | 1.39 | 13.85 | 2.66 | 2.91 | 8.1 | 32.8 | 50.0 | 34.6 | 15.4 | loam | 4.9 | 22.0 | 0.19 | 0.08 | 0.13 | 0.001 | 1.9 | 30.0 | 6.5 | 0.8 | <0.1 | 1.6 | 1.2 |
| | 42.0 - 52.0 | 8.2 | 8.2 | 1.68 | 19.85 | 2.37 | 6.11 | 9.5 | 35.8 | 40.0 | 36.8 | 23.2 | loam clay | 5.1 | 24.0 | 0.22 | 0.09 | 0.16 | <0.001 | 2.1 | 27.0 | 4.6 | 0.7 | <0.1 | 1.8 | 1.2 |
| 71.5 - 74.0 | 7.8 | 8.1 | 2.21 | 32.35 | 2.43 | 4.30 | 17.3 | 40.0 | 31.6 | 39.4 | 29.0 | loam | 4.3 | 28.0 | 0.21 | 0.08 | 0.19 | <0.001 | 2.5 | 21.0 | 1.5 | 1.0 | <0.1 | 1.4 | 4.0 | |
| 74.0 - 85.0 | 8.2 | 8.1 | 5.20 | 82.0 | 4.94 | 9.89 | 29.5 | 22.9 | 80.0 | 10.2 | 9.8 | sand loamy | 4.7 | 31.0 | 0.27 | 0.09 | 0.14 | <0.001 | 1.0 | 13.0 | 1.1 | 0.4 | <0.1 | 0.4 | 1.3 | |

Table B-1.--Analyses of overburden samples to determine suitability for plant growth, East Decker and North Extension areas.--Continued

| Core hole number | Depth below surface (feet) | Satur- ated paste | pH | | Soluble salts (millimhos) | Sodium (meq/l) | Calcium (meq/l) | Mag- nesium (meq/l) | SAR | Satur- ation percent | Texture (percent) | | Equip- valent soil class | Nitrate (ppm) | Ammonia (ppm) | B (ppm) | Se (ppm) | Mo (ppm) | Hg (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Cd (ppm) | Pb (ppm) | Ni (ppm) | | |
|------------------------------------------------------------------------------|----------------------------|-------------------------|-------------------------|-------------------|---------------------------|----------------|-----------------|------------------------|-------|-------------------------|-------------------|-----------|-----------------------------|---------------|---------------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|------|
| | | | Satur- ated paste | 1:5 dilu- tion | | | | | | | sand | silt clay | | | | | | | | | | | | | | | | |
| 1263 (cont.) | 85.0 - 90.5 | 8.2 | 8.5 | 1.65 | 24.7 | 0.41 | 0.31 | 40.1 | 54.1 | 42.0 | 32.4 | 25.6 | clay | 4.0 | 68.0 | 0.47 | 0.09 | 0.11 | <0.001 | 1.7 | 27.0 | 2.0 | 1.1 | <0.1 | 0.6 | 1.6 | | |
| | 91.5 - 94.5 | 7.1 | 8.0 | 3.85 | 54.4 | 5.18 | 4.09 | 24.7 | 38.7 | 31.6 | 45.2 | 23.2 | loam | 4.2 | 34.0 | 0.26 | 0.09 | 0.16 | <0.001 | 1.9 | 21.0 | 8.0 | 0.7 | <0.1 | 0.5 | 2.0 | | |
| | 94.5 - 96.5 | 8.1 | 8.5 | 2.09 | 38.0 | 0.58 | 0.75 | 46.4 | 46.5 | 29.6 | 40.6 | 29.8 | loam | 4.0 | 57.0 | 0.43 | 0.09 | 0.14 | <0.001 | 1.7 | 25.0 | 3.7 | 0.7 | <0.1 | 0.6 | 2.0 | | |
| | 96.5 - 106.0 | 8.5 | 8.5 | 2.11 | 32.35 | 0.51 | 0.33 | 47.2 | 24.6 | 58.8 | 31.2 | 10.0 | loam | 3.9 | 31.0 | 0.25 | 0.09 | 0.16 | <0.001 | 1.1 | 28.0 | 2.0 | 0.4 | <0.1 | 0.7 | 1.2 | | |
| | 106.0 - 113.0 | 8.1 | 8.4 | 2.38 | 38.5 | 0.57 | 0.81 | 44.4 | 24.2 | 70.8 | 17.2 | 12.0 | loam | 3.6 | 29.0 | 0.23 | 0.08 | 0.19 | <0.001 | 1.4 | 18.0 | 1.6 | 0.4 | <0.1 | 0.5 | 1.7 | | |
| | 113.0 - 120.5 | 8.4 | 8.5 | 1.88 | 30.5 | 0.62 | 0.17 | 47.0 | 33.7 | 36.2 | 43.2 | 20.0 | loam | 3.8 | 31.0 | 0.26 | 0.09 | 0.16 | <0.001 | 2.0 | 27.0 | 3.6 | 0.5 | <0.1 | 0.8 | 1.3 | | |
| | 120.5 - 130.5 | 8.5 | 8.6 | 1.29 | 20.5 | 0.34 | 0.34 | 34.2 | 52.5 | 20.8 | 35.2 | 44.0 | clay | 3.2 | 47.0 | 0.31 | 0.09 | 0.15 | <0.001 | 3.1 | 38.0 | 3.1 | 1.4 | <0.1 | 1.4 | 5.0 | | |
| | 130.5 - 138.0 | 8.2 | 8.4 | 1.34 | 20.5 | 0.45 | 0.87 | 10.5 | 49.5 | 20.8 | 37.2 | 42.0 | clay | 3.4 | 52.0 | 0.23 | 0.09 | 0.13 | <0.001 | 2.7 | 27.0 | 2.5 | 1.2 | <0.1 | 1.4 | 3.4 | | |
| North Extension mine area | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (Values for nitrogen, zinc, iron, manganese, and copper were not determined) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1267 | 0.0 - 5.0 | 8.2 | 8.12 | 7.10 | 101.40 | 21.32 | 56.02 | 16.5 | 40.56 | 62.8 | 29.6 | 7.6 | sandy | --- | --- | --- | 0.66 | 0.04 | 0.50 | 0.045 | --- | --- | --- | --- | --- | 0.20 | 1.24 | 0.96 |
| | 5.0 - 10.0 | 8.4 | 8.28 | 9.40 | 196.50 | 20.90 | 70.50 | 37.6 | 37.55 | 63.2 | 33.2 | 3.6 | sandy | --- | --- | --- | 0.61 | 0.55 | 0.59 | 0.048 | --- | --- | --- | --- | --- | 0.16 | 1.10 | 1.04 |
| | 10.0 - 20.0 | 8.5 | 8.25 | 8.60 | 160.00 | 15.44 | 40.15 | 30.2 | 51.26 | 45.6 | 50.8 | 3.6 | loam | --- | --- | --- | 1.23 | 0.49 | 0.60 | 0.055 | --- | --- | --- | --- | --- | 0.16 | 1.32 | 0.70 |
| | 20.0 - 30.0 | 8.6 | 8.48 | 7.10 | 137.00 | 9.17 | 26.73 | 32.3 | 57.87 | 44.0 | 50.0 | 6.0 | loam | --- | --- | --- | 2.49 | 0.42 | 0.84 | 0.053 | --- | --- | --- | --- | --- | 0.16 | 1.24 | 0.80 |
| | 30.0 - 35.0 | 8.8 | 9.10 | 4.50 | 94.80 | 2.06 | 9.16 | 40.2 | 36.29 | 72.0 | 24.0 | 4.0 | loam | --- | --- | --- | 2.97 | 0.12 | 0.72 | 0.045 | --- | --- | --- | --- | --- | 0.20 | 0.88 | 0.72 |
| | 35.0 - 39.0 | 8.5 | 8.69 | 3.54 | 67.30 | 16.27 | 4.79 | 65.7 | 35.75 | 70.4 | 18.0 | 11.6 | sandy | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 45.0 - 47.0 | 8.2 | 8.5 | 1.17 | 18.0 | 1.22 | 1.13 | 16.6 | 53.51 | 13.2 | 53.6 | 33.2 | loam | --- | --- | --- | 1.29 | 0.04 | 0.20 | 0.040 | --- | --- | --- | --- | --- | 0.22 | 1.22 | 1.36 |
| | 47.0 - 51.0 | 7.5 | 7.9 | 1.47 | 21.7 | 1.64 | 1.27 | 18.0 | 47.49 | 13.2 | 59.6 | 27.2 | loam | --- | --- | --- | 0.90 | 0.04 | 0.83 | 0.062 | --- | --- | --- | --- | --- | 0.20 | 1.32 | 4.56 |
| | 72.0 - 81.0 | 8.2 | 8.5 | 1.55 | 15.9 | 2.74 | 4.24 | 8.5 | 31.48 | 29.6 | 45.2 | 25.2 | loam | --- | --- | --- | 0.53 | 0.05 | 1.80 | 0.038 | --- | --- | --- | --- | --- | 0.17 | 3.52 | 2.78 |
| | 81.0 - 86.0 | 8.3 | 8.5 | 1.72 | 28.1 | 1.44 | 1.17 | 24.6 | 43.42 | 22.8 | 48.0 | 29.2 | loam | --- | --- | --- | 0.32 | 0.06 | 1.41 | 0.042 | --- | --- | --- | --- | --- | 0.12 | 2.03 | 1.34 |
| | 86.0 - 90.0 | 7.1 | 7.8 | 3.99 | 52.2 | 15.76 | 12.48 | 13.9 | 66.44 | 20.8 | 35.6 | 43.6 | clay | --- | --- | --- | 0.49 | 0.46 | 1.90 | 0.512 | --- | --- | --- | --- | --- | 0.18 | 4.32 | 2.88 |
| | 91.0 - 101.0 | 8.1 | 8.6 | 2.47 | 41.4 | 1.96 | 1.49 | 31.5 | 35.96 | 28.8 | 40.0 | 31.2 | loam | --- | --- | --- | 0.25 | 0.08 | 1.46 | 0.62 | --- | --- | --- | --- | --- | 0.15 | 3.20 | 2.00 |
| | 111.0 - 122.0 | 7.8 | 8.3 | 3.35 | 55.9 | 5.97 | 4.91 | 24.4 | 65.69 | 16.8 | 36.0 | 47.2 | clay | --- | --- | --- | 0.44 | 0.23 | 2.05 | 0.078 | --- | --- | --- | --- | --- | 0.16 | 3.64 | 3.04 |
| | 122.0 - 131.0 | 8.0 | 8.4 | 2.82 | 45.0 | 3.44 | 2.51 | 26.1 | 59.45 | 28.8 | 35.6 | 35.6 | loam | --- | --- | --- | 0.30 | 0.16 | 2.27 | 0.092 | --- | --- | --- | --- | --- | 0.12 | 2.30 | 2.48 |
| | 131.0 - 141.0 | 8.4 | 8.6 | 2.10 | 36.1 | 1.15 | 0.64 | 38.2 | 41.19 | 22.4 | 40.0 | 37.6 | loam | --- | --- | --- | 0.33 | 0.28 | 2.08 | 0.044 | --- | --- | --- | --- | --- | 0.10 | 3.36 | 1.96 |
| | 141.0 - 144.0 | 8.7 | 8.7 | 1.33 | 31.2 | 0.89 | 0.47 | 37.8 | 26.81 | 52.8 | 21.6 | 25.6 | sandy | --- | --- | --- | 0.37 | 0.17 | 0.59 | 0.125 | --- | --- | --- | --- | --- | 0.08 | 2.50 | 2.10 |
| | 144.0 - 151.0 | 8.2 | 8.5 | 2.42 | 40.8 | 1.90 | 0.73 | 35.6 | 58.88 | 14.4 | 36.4 | 49.2 | clay | --- | --- | --- | 0.37 | 0.35 | 3.20 | 0.055 | --- | --- | --- | --- | --- | 0.10 | 4.10 | 1.64 |
| | 151.0 - 161.0 | 7.6 | 8.2 | 2.79 | 45.7 | 4.39 | 3.26 | 23.4 | 49.38 | 26.8 | 34.0 | 39.2 | loam | --- | --- | --- | 0.37 | 0.28 | 2.39 | 0.065 | --- | --- | --- | --- | --- | 0.14 | 3.04 | 2.92 |
| | 161.0 - 168.5 | 8.4 | 8.4 | 1.97 | 33.9 | 1.01 | 0.17 | 44.1 | 40.75 | 44.4 | 30.0 | 25.6 | loam | --- | --- | --- | 0.37 | 0.28 | 2.39 | 0.036 | --- | --- | --- | --- | --- | 0.10 | 2.30 | 1.88 |
| | 168.5 - 172.0 | 8.0 | 8.6 | 2.10 | 36.9 | 0.91 | 0.31 | 47.3 | 85.13 | 20.4 | 31.6 | 48.0 | clay | --- | --- | --- | 0.38 | 0.05 | 2.33 | 0.072 | --- | --- | --- | --- | --- | 0.20 | 3.36 | 4.24 |
| | 172.0 - 177.0 | 7.9 | 8.2 | 1.19 | 21.7 | 0.39 | 0.13 | 42.6 | 82.50 | 24.0 | 26.0 | 50.0 | clay | --- | --- | --- | 0.89 | 0.27 | 0.46 | 0.214 | --- | --- | --- | --- | --- | 0.11 | 3.30 | 6.00 |

Table B-1.--Analyses of overburden samples to determine suitability for plant growth, East Decker and North Extension areas.--Continued

| Core hole Number | Depth below surface (feet) | pH | | Soluble dilution (millimhos) | Sodium (meq/l) | Calcium (meq/l) | Mag- nesium (meq/l) | SAR | Satur- ation percent | Texture (percent) | | Equiv- alent soil class | Nitrogen | | B (ppm) | Se (ppm) | Mo (ppm) | Hg (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Cd (ppm) | Pb (ppm) | Ni (ppm) | |
|---------------------|----------------------------------|-------------------------|------|------------------------------------|-------------------|--------------------|---------------------------|------|----------------------------|----------------------|------|----------------------------------|------------------|------------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------|
| | | Satur- ated paste | 1.5 | | | | | | | sand | silt | | Nitrate (ppm) | Ammonia (ppm) | | | | | | | | | | | | |
| 1268 | 0.0 - 5.0 | 8.6 | 8.6 | 0.49 | 1.54 | 2.16 | 1.06 | 1.2 | 60.97 | 35.6 | 33.6 | 30.8 | loam | clay | ---- | 0.19 | 0.05 | 0.26 | 0.058 | --- | --- | --- | --- | 0.20 | 1.48 | 1.92 |
| | 5.0 - 10.0 | 8.6 | 8.6 | 0.41 | 1.52 | 1.85 | 4.26 | 0.9 | 46.24 | 45.6 | 33.6 | 20.8 | loam | loam | ---- | 0.37 | 0.03 | 0.53 | 0.056 | --- | --- | --- | --- | 0.16 | 1.12 | 1.12 |
| | 10.0 - 15.0 | 8.4 | 8.46 | 0.41 | 1.36 | 1.50 | 11.12 | 0.5 | 50.35 | 41.6 | 31.6 | 26.8 | loam | loam | ---- | 0.48 | 0.23 | 0.75 | 0.068 | --- | --- | --- | --- | 0.18 | 1.30 | 1.02 |
| | 15.0 - 25.0 | 8.5 | 8.48 | 0.64 | 2.37 | 1.79 | 4.28 | 1.4 | 53.08 | 43.6 | 31.6 | 24.8 | loam | loam | ---- | 0.83 | 0.06 | 1.27 | 0.057 | --- | --- | --- | --- | 0.16 | 0.88 | 0.84 |
| | 25.0 - 35.0 | 8.7 | 8.52 | 0.94 | 0.36 | 1.24 | 3.54 | 0.2 | 59.38 | 33.6 | 39.6 | 26.8 | loam | loam | ---- | 1.10 | 0.11 | 1.80 | 0.043 | --- | --- | --- | --- | 0.15 | 0.68 | 1.28 |
| | 44.0 - 55.0 | 8.2 | 8.3 | 0.99 | 10.10 | 2.55 | 2.79 | 6.2 | 31.23 | 26 | 50 | 24 | loam clay | loam clay | ---- | 0.49 | 0.09 | 1.89 | 0.065 | --- | --- | --- | --- | 0.19 | 1.00 | 2.56 |
| | 75.0 - 81.0 | 7.9 | 8.0 | 1.12 | 13.00 | 1.97 | 2.38 | 8.8 | 36.33 | 50 | 26 | 24 | loam | loam | ---- | 0.01 | 0.19 | 2.39 | 0.064 | --- | --- | --- | --- | 0.13 | 3.48 | 2.78 |
| | 81.0 - 91.0 | 8.0 | 8.2 | 1.85 | 26.20 | 2.78 | 3.13 | 15.2 | 37.97 | 36 | 34 | 30 | loam | loam | ---- | 0.01 | 0.10 | 1.91 | 0.086 | --- | --- | --- | --- | 0.13 | 2.16 | 3.08 |
| | 91.0 - 94.8 | 7.0 | 8.2 | 2.67 | 47.00 | 4.12 | 3.74 | 23.7 | 61.23 | 26 | 31.6 | 42.4 | clay sandy | clay sandy | ---- | 0.01 | 0.49 | 4.83 | 0.126 | --- | --- | --- | --- | 0.14 | 4.40 | 5.32 |
| | 94.8 - 101.0 | 8.0 | 8.3 | 2.53 | 43.70 | 3.35 | 2.79 | 24.9 | 28.21 | 49.6 | 28 | 22.4 | loam | loam | ---- | 0.01 | 0.15 | 2.98 | 0.056 | --- | --- | --- | --- | 0.08 | 2.30 | 2.10 |
| | 101.0 - 106.0 | 8.3 | 8.4 | 2.08 | 39.00 | 1.54 | 1.75 | 30.4 | 33.67 | 33.2 | 46 | 24.8 | loam | loam | ---- | 0.01 | 0.14 | 2.43 | 0.062 | --- | --- | --- | --- | 0.16 | 1.44 | 2.60 |
| | 106.0 - 114.0 | 7.9 | 8.4 | 2.98 | 56.70 | 3.35 | 2.22 | 33.9 | 52.22 | 15.8 | 40.2 | 44.0 | clay | clay | ---- | 0.01 | 0.48 | 2.59 | 0.106 | --- | --- | --- | --- | 0.20 | 3.50 | 4.74 |
| | 114.0 - 121.0 | 8.1 | 8.6 | 2.21 | 41.70 | 1.50 | 0.83 | 40.3 | 48.63 | 39.2 | 26.8 | 34 | loam | loam | ---- | 0.48 | 0.13 | 2.11 | 0.062 | --- | --- | --- | --- | 0.17 | 1.92 | 3.54 |
| | 121.0 - 131.0 | 8.0 | 8.5 | 1.91 | 38.60 | 0.88 | 0.64 | 44.3 | 43.08 | 17.2 | 42.4 | 40.4 | loam | loam | ---- | 0.46 | 0.17 | 3.65 | 0.088 | --- | --- | --- | --- | 0.18 | 3.12 | 3.88 |
| | 131.0 - 141.0 | 8.4 | 8.4 | 1.68 | 55.10 | 1.50 | 1.26 | 46.9 | 33.16 | 49.2 | 32.4 | 18.4 | loam | loam | ---- | 0.07 | 0.06 | 2.17 | 0.062 | --- | --- | --- | --- | 0.09 | 2.16 | 2.10 |
| | 141.0 - 146.8 | 8.6 | 8.6 | 1.69 | 31.70 | 0.76 | 0.98 | 34.0 | 26.90 | 41.2 | 36.4 | 22.4 | loam | loam | ---- | 0.20 | 0.04 | 1.39 | 0.052 | --- | --- | --- | --- | 0.11 | 1.92 | 2.00 |
| | 146.8 - 151.0 | 8.4 | 8.5 | 1.81 | 29.70 | 0.88 | 0.58 | 34.7 | 44.76 | 11.2 | 42.4 | 46.4 | clay | clay | ---- | 0.26 | 0.05 | 3.04 | 0.066 | --- | --- | --- | --- | 0.13 | 3.80 | 3.96 |
| 1269 | 151.0 - 161.0 | 7.5 | 8.4 | 2.88 | 68.50 | 3.50 | 2.96 | 38.1 | 62.08 | 10 | 40.4 | 49.6 | clay | clay | ---- | 0.56 | 0.09 | 2.81 | 0.104 | --- | --- | --- | --- | 0.16 | 3.70 | 5.08 |
| | 161.0 - 171.0 | 8.4 | 8.5 | 1.90 | 33.70 | 0.98 | 0.66 | 37.2 | 28.00 | 42.0 | 29.6 | 28.4 | loam | loam | ---- | 0.31 | 0.03 | 1.63 | 0.080 | --- | --- | --- | --- | 0.14 | 3.52 | 3.14 |
| | 171.0 - 176.0 | 7.9 | 8.3 | 1.09 | 17.55 | 0.68 | 0.30 | 25.1 | 83.54 | 25.6 | 24 | 50.4 | clay | clay | ---- | 0.62 | 0.04 | 0.47 | 0.256 | --- | --- | --- | --- | 0.13 | 5.32 | 10.14 |
| | 176.0 - 180.0 | 8.3 | 8.6 | 2.20 | 42.05 | 0.97 | 0.60 | 47.3 | 35.40 | 37.6 | 26.0 | 36.4 | loam | loam | ---- | 0.13 | 0.05 | 1.97 | 0.098 | --- | --- | --- | --- | 0.14 | 3.76 | 3.64 |
| | 204.0 - 210.0 | 8.6 | 8.6 | 1.55 | 22.40 | 1.03 | 0.58 | 24.9 | 21.65 | 43.6 | 28.0 | 28.4 | loam | loam | ---- | 0.09 | 0.01 | 1.35 | 0.088 | --- | --- | --- | --- | 0.08 | 5.10 | 2.20 |
| | 0.0 - 3.0 | 8.4 | 8.33 | 0.49 | 3.22 | 0.54 | 3.45 | 2.3 | 58.81 | 28.4 | 36.4 | 35.2 | loam | loam | ---- | 0.32 | 0.04 | 0.49 | 0.014 | --- | --- | --- | --- | 0.22 | 1.30 | 0.08 |
| | 3.0 - 5.0 | 8.7 | 8.51 | 0.88 | 3.43 | 1.19 | 8.26 | 1.6 | 64.62 | 48.4 | 36.4 | 15.2 | loam | sandy | ---- | 0.58 | 0.03 | 0.33 | 0.014 | --- | --- | --- | --- | 0.16 | 0.96 | 0.06 |
| | 5.0 - 8.0 | 9.0 | 8.63 | 0.57 | 1.93 | 2.35 | 3.11 | 1.2 | 38.44 | 58.4 | 28.4 | 13.2 | loam | sandy | ---- | 0.55 | 0.07 | 1.45 | 0.006 | --- | --- | --- | --- | 0.14 | 1.08 | 0.06 |
| | 8.0 - 18.0 | 8.8 | 8.55 | 0.87 | 6.33 | 0.95 | 2.58 | 4.8 | 28.59 | 76.4 | 14 | 9.6 | loam | sandy | ---- | 0.27 | 0.05 | 0.61 | 0.001 | --- | --- | --- | --- | 0.13 | 0.60 | 0.06 |
| | 8.0 - 18.0 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 0.32 | 0.06 | 0.66 | 0.006 | --- | --- | --- | --- | 0.11 | 0.72 | 0.06 |
| | 51.0 - 53.0 | 8.2 | 8.6 | 1.53 | 12.20 | 5.29 | 5.41 | 5.3 | 63.58 | 44.4 | 32.0 | 23.6 | loam | loam | ---- | 0.12 | 0.07 | 2.66 | 0.016 | --- | --- | --- | --- | 0.18 | 1.08 | 0.16 |
| | 74.0 - 77.0 | 8.4 | 8.5 | 1.17 | 11.90 | 2.22 | 2.28 | 7.9 | 48.83 | 28.4 | 36.4 | 35.2 | loam | clay | ---- | 0.08 | 0.09 | 2.60 | 0.006 | --- | --- | --- | --- | 0.11 | 5.92 | 0.25 |
| | 77.0 - 81.0 | 8.6 | 8.7 | 1.27 | 11.00 | 2.86 | 3.96 | 6.0 | 36.85 | 48.4 | 29.6 | 22.0 | loam | loam | ---- | 0.02 | 0.03 | 2.71 | 0.001 | --- | --- | --- | --- | 0.14 | 2.32 | 0.21 |
| | 81.0 - 92.0 | 8.1 | 8.5 | 1.86 | 26.00 | 2.58 | 2.56 | 16.2 | 50.56 | 23.6 | 36.0 | 40.4 | clay | clay | ---- | 0.15 | 0.08 | 4.62 | 0.016 | --- | --- | --- | --- | 0.23 | 4.24 | 0.36 |
| | 92.4 - 101.0 | 8.6 | 8.6 | 1.78 | 27.90 | 0.95 | 2.00 | 23.0 | 51.41 | 20.0 | 35.6 | 44.4 | clay | clay | ---- | 0.07 | 0.07 | 53.6 | 0.016 | --- | --- | --- | --- | 0.23 | 6.28 | 0.42 |
| | 101.0 - 111.0 | 8.6 | 8.6 | 2.10 | 32.00 | 1.24 | 1.09 | 29.7 | 42.34 | 24.0 | 40.0 | 36.0 | loam | loam | ---- | 0.10 | 0.05 | 3.18 | 0.006 | --- | --- | --- | --- | 0.23 | 3.00 | 0.30 |

Table B-1.--Analyses of overburden samples to determine suitability for plant growth, East Decker and North Extension areas.--Continued

| Core hole number | Depth below surface (feet) | pH | | Soluble salts (millimhos) | Sodium (meq/l) | Calcium (meq/l) | Mag-nesium (meq/l) | SAR | Satur-ation percent | Texture (percent) | | Equip-ivalent soil cines | Nitrogen | | B (ppm) | Se (ppm) | Mo (ppm) | Hg (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Cd (ppm) | Pb (ppm) | Ni (ppm) |
|------------------|----------------------------|------------------|---------------|---------------------------|----------------|-----------------|--------------------|-------|---------------------|-------------------|-----------|--------------------------|---------------|---------------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| | | Satur-ated paste | 1:5 dilu-tion | | | | | | | sand | silt | | Nitrate (ppm) | Ammonia (ppm) | | | | | | | | | | | |
| 1269 (cont.) | 111.0 - 121.0 | 8.6 | 8.6 | 1.81 | 31.00 | 0.93 | 0.34 | 38.8 | 49.87 | 12.0 | 42.4 | 45.6 clay | ---- | ---- | 0.09 | 0.04 | 3.84 | 0.015 | ---- | ---- | ---- | ---- | 0.23 | 3.40 | 0.33 |
| | 121.0 - 131.0 | 8.3 | 8.4 | 1.78 | 32.20 | 0.64 | 0.94 | 36.3 | 38.92 | 29.6 | 40.0 | 30.4 loam | ---- | ---- | 0.07 | 0.02 | 2.58 | 0.001 | ---- | ---- | ---- | ---- | 0.21 | 2.40 | 0.18 |
| | 131.0 - 141.0 | 8.3 | 8.4 | 1.62 | 30.10 | 0.32 | 0.49 | 47.6 | 26.42 | 23.0 | 40.0 | 28.0 loam | ---- | ---- | 0.07 | 0.02 | 2.63 | 0.001 | ---- | ---- | ---- | ---- | 0.23 | 2.80 | 0.23 |
| | 141.0 - 151.0 | 8.4 | 8.4 | 1.79 | 31.40 | 0.82 | 1.49 | 29.2 | 39.86 | 36.0 | 37.6 | 26.4 loam | ---- | ---- | 0.06 | 0.02 | 3.11 | 0.001 | ---- | ---- | ---- | ---- | 0.21 | 2.16 | 0.18 |
| | 151.0 - 161.0 | 8.4 | 8.4 | 1.90 | 27.50 | 1.38 | 2.17 | 20.6 | 33.79 | 21.6 | 67.4 | 11.0 loam | ---- | ---- | 0.15 | 0.01 | 2.68 | 0.001 | ---- | ---- | ---- | ---- | 0.14 | 1.90 | 0.12 |
| | 161.0 - 171.0 | 8.3 | 8.4 | 1.88 | 26.30 | 1.34 | 1.00 | 24.3 | 36.07 | 23.6 | 52.0 | 24.4 loam | ---- | ---- | 0.11 | 0.01 | 2.73 | 0.001 | ---- | ---- | ---- | ---- | 0.17 | 2.40 | 0.13 |
| | 171.0 - 181.0 | 8.2 | 8.3 | 2.32 | 39.50 | 1.32 | 1.17 | 34.8 | 29.51 | 25.6 | 51.6 | 22.8 loam | ---- | ---- | 0.05 | 0.01 | 2.81 | 0.001 | ---- | ---- | ---- | ---- | 0.15 | 2.38 | 0.16 |
| | 181.0 - 189.0 | 8.2 | 8.4 | 2.72 | 49.40 | 2.06 | 1.79 | 35.7 | 27.33 | 25.6 | 48.0 | 26.4 loam | ---- | ---- | 0.06 | 0.02 | 3.55 | 0.004 | ---- | ---- | ---- | ---- | 0.16 | 2.30 | 0.20 |
| | 189.0 - 193.0 | 8.3 | 8.6 | 1.30 | 22.40 | 0.42 | 0.21 | 39.6 | 96.27 | 32.0 | 19.2 | 48.8 clay | ---- | ---- | 0.28 | 0.01 | 0.59 | 0.122 | ---- | ---- | ---- | ---- | 0.24 | 3.10 | 0.33 |
| | 0.0 - 5.0 | 8.3 | 8.59 | 0.51 | 2.52 | 1.46 | 3.02 | 1.7 | 28.79 | 40 | 33.6 | 26.4 loam | ---- | ---- | 0.20 | 0.01 | 0.23 | 0.110 | ---- | ---- | ---- | ---- | 0.17 | 1.28 | 0.96 |
| 1270 | 5.0 - 8.0 | 8.2 | 8.50 | 1.47 | 6.60 | 5.15 | 12.14 | 2.2 | 48.90 | 50 | 29.2 | 20.8 loam | ---- | ---- | 1.16 | 0.02 | 0.18 | 0.096 | ---- | ---- | ---- | ---- | 0.17 | 1.00 | 0.68 |
| | 8.0 - 13.5 | 8.0 | 8.29 | 4.80 | 68.20 | 23.38 | 53.78 | 11.0 | 41.80 | 70 | 19.2 | 10.8 loam | ---- | ---- | 1.38 | 0.04 | 0.31 | 0.102 | ---- | ---- | ---- | ---- | 0.13 | 0.80 | 0.74 |
| | 36.6 - 43.9 | 8.1 | 8.6 | 1.04 | 7.25 | 3.02 | 3.89 | 3.8 | 51.50 | 22.4 | 44.4 | 33.2 loam | ---- | ---- | 0.01 | 0.01 | 3.90 | 0.160 | ---- | ---- | ---- | ---- | 0.14 | 3.00 | 8.20 |
| | 64.8 - 70.0 | 8.5 | 8.6 | 1.07 | 15.25 | 2.25 | 3.58 | 8.5 | 42.05 | 28.4 | 36.0 | 35.6 loam | ---- | ---- | 0.20 | 0.01 | 5.36 | 0.102 | ---- | ---- | ---- | ---- | 0.12 | 7.30 | 6.22 |
| | 70.0 - 76.0 | 8.5 | 8.6 | 2.16 | 34.11 | 1.79 | 2.36 | 23.7 | 38.48 | 12.4 | 50.0 | 37.6 loam | ---- | ---- | 0.08 | 0.22 | 3.45 | 0.114 | ---- | ---- | ---- | ---- | 0.13 | 3.76 | 5.14 |
| | 76.0 - 80.0 | 7.1 | 8.4 | 4.10 | 68.30 | 9.87 | 6.35 | 24.0 | 58.82 | 30.0 | 24.0 | 46.0 clay | ---- | ---- | 0.04 | 0.16 | 1.47 | 0.210 | ---- | ---- | ---- | ---- | 0.15 | 6.08 | 9.44 |
| | 80.0 - 90.0 | 7.6 | 8.4 | 2.98 | 43.70 | 5.75 | 3.24 | 20.6 | 49.03 | 20.0 | 40.0 | 40.0 loam | ---- | ---- | 0.41 | 0.14 | 3.06 | 0.136 | ---- | ---- | ---- | ---- | 0.12 | 5.10 | 5.86 |
| | 90.0 - 92.4 | 8.9 | 8.9 | 2.20 | 38.35 | 0.72 | 0.94 | 42.1 | 22.21 | 40.0 | 31.6 | 28.4 loam | ---- | ---- | 0.25 | 0.09 | 2.06 | 0.082 | ---- | ---- | ---- | ---- | 0.10 | 5.30 | 7.76 |
| | 92.4 - 95.0 | 8.6 | 8.6 | 2.37 | 38.55 | 1.03 | 1.47 | 34.5 | 41.05 | 6.0 | 46.4 | 47.6 clay | ---- | ---- | 0.05 | 0.08 | 3.62 | 0.102 | ---- | ---- | ---- | ---- | 0.16 | 4.90 | 6.08 |
| | 95.0 - 100.0 | 8.9 | 8.9 | 1.90 | 31.15 | 0.89 | 0.87 | 33.2 | 28.20 | 32.0 | 34.4 | 33.6 loam | ---- | ---- | 0.15 | 0.21 | 1.15 | 0.068 | ---- | ---- | ---- | ---- | 0.12 | 4.10 | 4.24 |
| 100.0 - 107.2 | 8.6 | 8.7 | 2.02 | 32.60 | 0.80 | 0.85 | 35.6 | 27.84 | 22.0 | 50.0 | 28.0 loam | ---- | ---- | 0.21 | 0.10 | 2.86 | 0.048 | ---- | ---- | ---- | ---- | 0.15 | 3.18 | 4.48 | |
| 107.2 - 110.0 | 8.7 | 8.7 | 2.42 | 45.90 | 1.09 | 1.44 | 40.7 | 35.99 | 12.0 | 40.0 | 48.0 clay | ---- | ---- | 0.10 | 0.26 | 4.44 | 0.092 | ---- | ---- | ---- | ---- | 0.14 | 3.90 | 4.70 | |
| 110.0 - 113.1 | 8.2 | 8.7 | 3.10 | 55.10 | 1.91 | 2.30 | 37.9 | 50.72 | 20.0 | 26.0 | 52.0 clay | ---- | ---- | 0.01 | 0.11 | 4.17 | 0.142 | ---- | ---- | ---- | ---- | 0.16 | 5.74 | 12.74 | |
| 113.1 - 120.0 | 8.4 | 8.4 | 2.19 | 41.00 | 1.52 | 2.66 | 28.4 | 32.83 | 20.0 | 45.0 | 26.0 loam | ---- | ---- | 0.01 | 0.07 | 2.20 | 0.078 | ---- | ---- | ---- | ---- | 0.09 | 4.60 | 5.32 | |
| 120.0 - 130.0 | 8.8 | 8.9 | 1.57 | 21.90 | 0.99 | 1.43 | 19.9 | 22.03 | 41.2 | 38.4 | 20.4 loam | ---- | ---- | 0.01 | 0.04 | 1.16 | 0.054 | ---- | ---- | ---- | ---- | 0.08 | 2.70 | 2.80 | |
| 130.0 - 140.0 | 8.8 | 8.8 | 2.00 | 31.75 | 1.13 | 1.41 | 28.2 | 33.02 | 20.0 | 39.6 | 40.4 clay | ---- | ---- | 0.22 | 0.14 | 1.99 | 0.082 | ---- | ---- | ---- | ---- | 0.15 | 5.80 | ---- | |
| 140.0 - 147.0 | 7.9 | 8.5 | 3.01 | 43.70 | 5.01 | 3.51 | 21.2 | 58.02 | 10.0 | 37.6 | 52.4 clay | ---- | ---- | 0.01 | 0.01 | 5.70 | 0.130 | ---- | ---- | ---- | ---- | 0.13 | 5.96 | 8.18 | |
| 147.0 - 157.0 | 8.6 | 8.7 | 1.83 | 27.60 | 1.67 | 1.29 | 21.8 | 24.66 | 38.0 | 33.2 | 28.8 loam | ---- | ---- | 0.01 | 0.04 | 2.42 | 0.080 | ---- | ---- | ---- | ---- | 0.09 | 3.52 | 3.34 | |
| 157.5 - 166.8 | 8.4 | 8.9 | 14.7 | 20.00 | 1.01 | 0.43 | 23.5 | 95.82 | 20.0 | 27.6 | 52.4 clay | ---- | ---- | 0.01 | 0.06 | 3.35 | 0.218 | ---- | ---- | ---- | ---- | 0.12 | 5.76 | 6.02 | |

Table B-1.--Analyses of overburden samples to determine suitability for plant growth, East Decker and North Extension areas.--Continued

| Core hole number | Depth below surface (feet) | pH | | Soluble salts (millimhos) | Sodium (meq/l) | Calcium (meq/l) | Magnesium (meq/l) | SAR | Saturation percent | Texture (percent) | | Equivalent soil class | Nitrogen | | Se (ppm) | Mo (ppm) | Hg (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Cd (ppm) | Pb (ppm) | Ni (ppm) |
|------------------|----------------------------|-----------------|--------------|---------------------------|----------------|-----------------|-------------------|------|--------------------|-------------------|------|-----------------------|---------------|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| | | Saturated paste | 1:5 dilution | | | | | | | silt | clay | | Nitrate (ppm) | Ammonia (ppm) | | | | | | | | | | |
| 1271 | 0.0 - 5.0 | 8.4 | 8.73 | 5.75 | 65.40 | 7.73 | 49.84 | 12.2 | 50.27 | 44 | 52 | 4 | ---- | ---- | 0.39 | 0.03 | 0.57 | 0.011 | ---- | ---- | ---- | 0.22 | 0.88 | 0.08 |
| | 5.0 - 10.0 | 8.5 | 8.21 | 8.00 | 116.00 | 23.13 | 71.07 | 19.9 | 57.08 | 37.6 | 62.4 | 0 | ---- | ---- | 1.47 | 0.42 | 0.41 | 0.018 | ---- | ---- | ---- | 0.26 | 1.36 | 0.06 |
| | 10.0 - 12.0 | 8.6 | 8.25 | 7.40 | 104.80 | 23.38 | 55.49 | 16.3 | 49.38 | 51.6 | 46.0 | 2.4 | ---- | ---- | 3.06 | 0.39 | 1.23 | 0.012 | ---- | ---- | ---- | 0.25 | 1.06 | 0.07 |
| | 12.0 - 22.0 | 8.5 | 8.41 | 5.10 | 50.70 | 25.13 | 35.35 | 9.3 | 36.78 | 69.6 | 27.2 | 3.2 | ---- | ---- | 1.25 | 0.26 | 0.59 | 0.009 | ---- | ---- | ---- | 0.14 | 0.84 | 0.06 |
| | 22.0 - 33.0 | 8.4 | 8.45 | 2.72 | 15.35 | 14.85 | 17.21 | 3.8 | 30.38 | 79.6 | 11.6 | 8.8 | ---- | ---- | 0.45 | 0.06 | 3.93 | 0.012 | ---- | ---- | ---- | 0.14 | 0.72 | 0.07 |
| | 54.0 - 59.5 | 7.0 | 7.70 | 3.23 | 41.50 | 10.36 | 11.35 | 12.6 | 66.54 | 48.8 | 36.4 | 14.8 | ---- | ---- | 0.40 | 0.27 | 3.87 | 0.078 | ---- | ---- | ---- | 0.23 | 1.10 | 0.44 |
| | 61.0 - 70.0 | 8.6 | 8.7 | 1.79 | 34.20 | 0.76 | 0.36 | 45.7 | 70.53 | 32.8 | 40.4 | 26.8 | ---- | ---- | 0.21 | 0.02 | 3.12 | 0.098 | ---- | ---- | ---- | 0.24 | 1.56 | 0.44 |
| | 71.5 - 75.2 | 8.2 | 8.5 | 1.29 | 36.20 | 0.50 | 0.83 | 44.2 | 52.91 | 42.8 | 38.0 | 19.2 | ---- | ---- | 0.12 | 0.02 | 0.36 | 0.087 | ---- | ---- | ---- | 0.25 | 1.00 | 0.31 |
| | 91.0 - 101.0 | 8.3 | 8.6 | 1.68 | 33.90 | 0.33 | 0.72 | 46.6 | 34.22 | 54.8 | 32.0 | 13.2 | ---- | ---- | 0.07 | 0.02 | 2.98 | 0.006 | ---- | ---- | ---- | 0.23 | 0.60 | 0.30 |
| | 101.0 - 111.0 | 7.7 | 8.2 | 2.66 | 52.30 | 0.93 | 1.75 | 45.2 | 54.15 | 44.8 | 34.0 | 21.2 | ---- | ---- | 0.06 | 0.12 | 3.51 | 0.034 | ---- | ---- | ---- | 0.21 | 2.96 | 0.44 |
| | 111.0 - 113.0 | 8.3 | 8.6 | 1.83 | 35.40 | 1.15 | 0.30 | 41.7 | 45.76 | 28.8 | 42.0 | 29.2 | ---- | ---- | 0.00 | 0.14 | 3.00 | 0.022 | ---- | ---- | ---- | 0.21 | 5.30 | 0.33 |
| | 113.0 - 123.0 | 8.3 | 8.6 | 1.71 | 31.00 | 0.64 | 0.77 | 37.1 | 48.77 | 40.8 | 34.0 | 25.2 | ---- | ---- | 0.01 | 0.06 | 1.91 | 0.015 | ---- | ---- | ---- | 0.22 | 3.10 | 0.30 |
| | 123.0 - 133.0 | 8.3 | 8.7 | 1.78 | 31.90 | 0.80 | 1.07 | 33.1 | 57.68 | 40.4 | 36.4 | 23.2 | ---- | ---- | 0.07 | 0.09 | 1.73 | 0.015 | ---- | ---- | ---- | 0.25 | 4.24 | 0.32 |
| | 133.0 - 143.0 | 8.6 | 8.6 | 1.57 | 29.60 | 0.23 | 0.34 | 55.9 | 47.90 | 46.8 | 32.0 | 21.2 | ---- | ---- | 0.02 | 0.05 | 2.06 | 0.009 | ---- | ---- | ---- | 0.21 | 2.50 | 0.21 |
| | 143.0 - 153.0 | 8.8 | 8.8 | 1.69 | 31.50 | 1.01 | 0.58 | 35.5 | 46.93 | 42.8 | 42.0 | 15.2 | ---- | ---- | 0.07 | 0.05 | 2.01 | 0.011 | ---- | ---- | ---- | 0.21 | 3.80 | 0.25 |
| | 153.0 - 163.0 | 8.9 | 9.0 | 1.51 | 26.00 | 0.52 | 0.47 | 37.1 | 34.30 | 48.8 | 36.0 | 15.2 | ---- | ---- | 0.02 | 0.02 | 1.84 | 0.010 | ---- | ---- | ---- | 0.14 | 3.40 | 0.20 |
| | 163.0 - 173.0 | 8.8 | 8.8 | 1.63 | 28.90 | 0.62 | 0.62 | 36.7 | 51.56 | 28.8 | 40.0 | 31.2 | ---- | ---- | 0.10 | 0.04 | 2.09 | 0.006 | ---- | ---- | ---- | 0.21 | 4.60 | 0.26 |
| 1272 | 173.0 - 183.0 | 8.5 | 8.6 | 1.91 | 33.0 | 1.24 | 1.07 | 30.8 | 56.10 | 46.8 | 28.0 | 25.2 | ---- | ---- | 0.04 | 0.22 | 1.95 | 0.018 | ---- | ---- | ---- | 0.22 | 2.72 | 0.20 |
| | 183.0 - 191.0 | 8.8 | 8.8 | 1.65 | 29.3 | 0.64 | 0.47 | 39.5 | 43.32 | 36.8 | 44.0 | 19.2 | ---- | ---- | 0.07 | 0.05 | 2.46 | 0.008 | ---- | ---- | ---- | 0.22 | 2.56 | 0.19 |
| | 191.0 - 198.0 | 8.2 | 8.5 | 1.77 | 33.0 | 0.45 | 0.30 | 54.3 | 73.32 | 28.8 | 24.0 | 47.2 | ---- | ---- | 0.13 | 0.09 | 2.33 | 0.094 | ---- | ---- | ---- | 0.22 | 5.30 | 0.62 |
| | 0.0 - 5.0 | 8.7 | 8.49 | 1.23 | 18.67 | 1.32 | 8.78 | 8.3 | 40.79 | 68 | 26.8 | 5.2 | ---- | ---- | 0.44 | 0.02 | 0.38 | 0.043 | ---- | ---- | ---- | 0.10 | 0.90 | 0.64 |
| | 5.0 - 10.0 | 8.7 | 8.46 | 0.34 | 3.14 | 0.45 | 1.73 | 3.0 | 41.67 | 60 | 22.4 | 17.6 | ---- | ---- | 0.56 | 0.01 | 0.26 | 0.046 | ---- | ---- | ---- | 0.16 | 0.90 | 0.64 |
| | 10.0 - 20.0 | 8.7 | 8.39 | 0.24 | 1.88 | 0.47 | 1.53 | 1.9 | 47.67 | 46 | 36 | 18 | ---- | ---- | 0.51 | 0.01 | 0.53 | 0.078 | ---- | ---- | ---- | 0.14 | 1.16 | 0.70 |
| | 20.0 - 24.0 | 8.5 | 8.41 | 0.73 | 3.45 | 1.69 | 5.24 | 1.9 | 37.75 | 72 | 18 | 10 | ---- | ---- | 0.55 | 0.02 | 1.27 | 0.058 | ---- | ---- | ---- | 0.12 | 0.96 | 0.66 |
| | 24.0 - 34.0 | 8.4 | 8.22 | 1.57 | 5.50 | 2.41 | 4.54 | 2.9 | 28.43 | 88 | 8 | 4 | ---- | ---- | 0.49 | 0.02 | 1.80 | 0.085 | ---- | ---- | ---- | 0.10 | 0.68 | 0.70 |
| | 55.2 - 59.0 | 7.76 | 7.86 | 1.28 | 7.0 | 2.65 | 3.24 | 4.1 | 12.70 | 20 | 46 | 34 | ---- | ---- | 1.31 | 0.21 | 1.89 | 0.068 | ---- | ---- | ---- | 0.25 | 1.56 | 4.80 |
| | 59.0 - 66.1 | 7.84 | 8.24 | 1.38 | 14.7 | 4.22 | 4.05 | 7.2 | 34.34 | 40 | 36 | 24 | ---- | ---- | 0.58 | 0.17 | 2.06 | 0.062 | ---- | ---- | ---- | 0.19 | 0.92 | 3.36 |
| | 67.2 - 76.1 | 7.53 | 7.98 | 1.91 | 34.3 | 1.96 | 1.45 | 26.3 | 86.60 | 20 | 42 | 38 | ---- | ---- | 0.62 | 0.42 | 2.86 | 0.192 | ---- | ---- | ---- | 0.23 | 4.40 | 1.11 |
| | 77.2 - 83.7 | 7.72 | 7.86 | 1.28 | 20.9 | 0.87 | 1.30 | 20.1 | 60.53 | 22 | 51.6 | 26.4 | ---- | ---- | 0.42 | 0.12 | 1.99 | 0.078 | ---- | ---- | ---- | 0.16 | 5.50 | 6.00 |
| | 98.2 - 103.0 | 8.32 | 8.46 | 1.78 | 35.2 | 0.68 | 0.30 | 50.3 | 118.57 | 34 | 41.6 | 24.4 | ---- | ---- | 0.32 | 0.03 | 2.34 | 0.030 | ---- | ---- | ---- | 0.17 | 3.60 | 2.50 |
| | 103.0 - 112.6 | 8.23 | 8.48 | 1.94 | 38.5 | 1.34 | 1.13 | 34.6 | 31.65 | 24 | 45.6 | 30.4 | ---- | ---- | 0.37 | 0.07 | 2.51 | 0.041 | ---- | ---- | ---- | 0.20 | 2.20 | 1.68 |
| | 112.6 - 114.7 | 6.94 | 8.00 | 4.10 | 65.9 | 17.49 | 8.24 | 18.4 | 84.09 | 26 | 28 | 46 | ---- | ---- | 0.59 | 0.26 | 8.97 | 0.189 | ---- | ---- | ---- | 0.21 | 4.70 | 6.30 |

Table B-1.--Analyses of overburden samples to determine suitability for plant growth, East Decker and North Extension areas.--Continued

| Core hole number | Depth below surface (feet) | Satur- ated paste | pH | 1.5 dilu- tion | Soluble salts (millimhos) | Sodium (meq/l) | Calcium (meq/l) | Mag- nesium (meq/l) | SAR | Satur- ation percent | Texture (percent) sand silt clay | Equiv- alent soil class | Nitrogen | | B (ppm) | Se (ppm) | Mo (ppm) | Hg (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Cd (ppm) | Pb (ppm) | Ni (ppm) | |
|---------------------|----------------------------------|-------------------------|------|----------------------|---------------------------------|-------------------|--------------------|---------------------------|-------|----------------------------|----------------------------------------|----------------------------------|------------------|------------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------|
| | | | | | | | | | | | | | Nitrate (ppm) | Ammonia (ppm) | | | | | | | | | | | | |
| 1272 (cont.) | 115.3 - 117.5 | 7.70 | 8.27 | 3.10 | 56.7 | 5.29 | 3.00 | 27.8 | 45.63 | 20 | 37.6 | 42.4 clay | --- | --- | 0.21 | 0.04 | 2.76 | 0.062 | --- | --- | --- | --- | --- | 0.15 | 4.98 | 3.44 |
| | 117.5 - 120.8 | 8.08 | 8.40 | 2.39 | 46.1 | 1.11 | 0.79 | 47.3 | 37.87 | 30 | 37.6 | 32.4 loam | --- | --- | 0.16 | 0.16 | 1.26 | 0.036 | --- | --- | --- | --- | --- | 0.15 | 3.90 | 1.20 |
| | 120.8 - 124.1 | 8.14 | 8.50 | 2.00 | 42.8 | 0.66 | 1.94 | 37.5 | 31.19 | 18 | 45.6 | 36.4 silty clay loam | --- | --- | 0.18 | 0.15 | 1.39 | 0.069 | --- | --- | --- | --- | --- | 0.20 | 2.92 | 2.44 |
| | 124.1 - 126.8 | 8.47 | 8.59 | 2.19 | 37.3 | 0.64 | 0.83 | 43.5 | 24.95 | 49.2 | 26 | 24.8 loam | --- | --- | 0.27 | 0.03 | 0.18 | 0.046 | --- | --- | --- | --- | --- | 0.14 | 1.80 | 1.96 |
| | 126.8 - 136.7 | 8.37 | 8.61 | 1.90 | 34.7 | 1.07 | 0.72 | 36.7 | 46.43 | 19.2 | 44 | 36.8 silty loam | --- | --- | 0.19 | 0.06 | 0.94 | 0.065 | --- | --- | --- | --- | --- | 0.20 | 4.56 | 1.96 |
| | 136.7 - 144.5 | 8.33 | 8.47 | 2.03 | 36.0 | 1.01 | 0.90 | 36.8 | 49.50 | 13.2 | 48 | 38.2 silty clay loam | --- | --- | 0.09 | 0.12 | 1.15 | 0.050 | --- | --- | --- | --- | --- | 0.21 | 4.16 | 1.72 |

Table B-2.--Major and trace element composition of two samples of overburden from the East Decker area
(From analyses by laboratories of the Geologic Division, U.S. Geological Survey, Denver, Colorado)

Element or oxide: (S) indicates that values were determined by semiquantitative spectrographic analysis.

Amount in sample: Values are in percent or parts per million (ppm) as indicated; < means less than the amount shown;

N means not detected. The results of spectrographic analyses in ppm are arbitrarily reported as the geometric midpoint between numerical brackets having the values 2.6, 3.8, 5.6, 8.3, 12, 18, 26, 38, 56, 83, 120, 180, 260, 380, and 560.

Geometric midpoints between these numerical brackets are 3, 5, 7, 10, 15, 20, 30, 50, 70, 100, 150, 200, 300, and 500. The precision of the spectrographic data is approximately a 68 percent confidence level for one bracket and a 95 percent confidence level for two brackets.

Sample 1: Represents 3 ft of core from hole 1256 in the SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 11, T. 9 S., R. 40 E. (fig. 38); interval sampled is 5 to 8 ft above the Dietz 1 coal bed at a depth of 122 to 125 ft below the surface.

Sample 2: Represents 7 ft of core from hole 1235 in the NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 12, T. 9 S., R. 40 E. (fig. 38); interval sampled is 21 to 28 ft below the Dietz 1 coal bed at a depth of 66 to 73 ft below the surface.

| Element or oxide | Amount in sample (percent) | | Element or oxide | Amount in sample (ppm) | | Element or oxide | Amount in sample (ppm) | |
|--------------------------------|-------------------------------|----------|------------------------|---------------------------|----------|------------------------|---------------------------|----------|
| | Sample 1 | Sample 2 | | Sample 1 | Sample 2 | | Sample 1 | Sample 2 |
| SiO ₂ | 57 | 65 | As | 5 | 8 | Co (S) | 7 | 7 |
| Al ₂ O ₃ | 9.7 | 11 | Cd | < 1 | < 1 | Cr (S) | 30 | 30 |
| CaO | 6.0 | 4.0 | Cu | 26 | 20 | Ga (S) | 20 | 20 |
| MgO | 2.62 | 2.66 | F | 630 | 760 | Ge (S) | N | N |
| Na ₂ O | .49 | .26 | Hg | .05 | .03 | La (S) | < 50 | 50 |
| K ₂ O | 1.8 | 2.5 | Li | 26 | 32 | Mo (S) | 5 | 7 |
| Fe ₂ O ₃ | 5.5 | 2.5 | Pb | < 25 | < 25 | Nb (S) | 15 | 10 |
| MnO | .058 | .41 | Sb | .3 | .7 | Ni (S) | 15 | 15 |
| TiO ₂ | .66 | .46 | Se | .4 | .1 | Sc (S) | 10 | 7 |
| P ₂ O ₅ | .18 | < .10 | Th | 8.9 | 12.7 | Sr (S) | 200 | 70 |
| SO ₃ | .12 | .14 | U | 2.7 | 3.0 | V (S) | 70 | 70 |
| Cl | < .10 | < .10 | Zn | 76 | 66 | Y (S) | 20 | 20 |
| | | | B (S) | 50 | 50 | Yb (S) | 3 | 3 |
| | | | Ba (S) | 500 | 300 | Zr (S) | 150 | 150 |
| | | | Be (S) | 1.5 | 1.5 | | | |

Table B-3. --Comparison of the total amount versus the plant-extractable amount of nine elements in two

samples of overburden in the East Decker area, Montana

[See table B-2 for identification and location of samples and for total composition values. Extractable trace elements analyzed by Northern Testing Laboratories according to procedures accepted by Montana Department of State Lands for soil analysis (data furnished by Decker Coal Co.). All values are in parts per million; < indicates less than the value shown.]

| Sample No. | Form of analysis | Cadmium | Copper | Mercury | Lead | Selenium | Zinc | Boron | Molybdenum | Nickel |
|------------|------------------|---------|--------|---------|--------------------|----------|------|-------|------------|--------|
| 1 | Total | <1 | 26 | 0.05 | < 25 ^{1/} | 0.4 | 76 | 50 | 5 | 15 |
| | Extractable | < .1 | 4.3 | < .001 | .2 | .07 | 8.8 | .14 | 1.2 | 1.7 |
| 2 | Total | <1 | 20. | .03 | < 25 ^{1/} | .1 | 66 | 50 | 7 | 15 |
| | Extractable | < .1 | .4 | < .001 | 1.0 | .02 | 1.5 | .76 | .15 | 1.4 |

^{1/} Indicates that the method of analysis, which could detect lead only in excess of 25 ppm, did not detect any lead in the sample. The amount of lead in the sample, therefore, was less than 25 ppm. According to Turekian and Wedepohl (1961, table 2), the average concentration of lead in shales in the earth's crust is 20 ppm. Values less than this amount, therefore, are not considered significant.

Table B-4.--Proximate, ultimate, Btu, and sulfur analyses of core samples (as received) of coal from the Decker area, showing range in values

[All analyses, except Btu, in percent. From data furnished by Decker Coal Co.]

| Moisture | Vol. matter | Fixed C | Ash | Btu | Hydrogen | Carbon | Nitrogen | Oxygen | Sulfur | Sulfate S | Pyritic S | Organic S |
|-------------------------------------|-------------|-----------|---------|-------------|----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|
| Low | High | Low | High | Low | High | Low | High | Low | High | Low | High | Low |
| High | Low | High | Low | High | Low | High | Low | High | Low | High | Low | High |
| North Extension | | | | | | | | | | | | |
| Anderson-Dietz 1 bed (one analysis) | | | | | | | | | | | | |
| 22.7 | 34.6 | 36.5 | 6.2 | 9,396 | 3.8 | 54.5 | 0.26 | 12.2 | 0.37 | 0.02 | 0.08 | 0.27 |
| Dietz 2 bed (8 analyses) | | | | | | | | | | | | |
| 19.8 25.9 | 23.1 34.3 | 38.7 47.7 | 4.1 7.4 | 9,078 9,965 | 3.4 4.0 | 52.8 56.9 | 0.2 1.2 | 0.01 13.1 | 0.33 0.51 | 0.01 0.02 | 0.02 0.11 | 0.18 0.40 |
| East Decker | | | | | | | | | | | | |
| Anderson bed (12 analyses) | | | | | | | | | | | | |
| 19.8 25.7 | 31.7 34.7 | 36.4 42.3 | 2.9 5.7 | 9,158 9,818 | 3.7 3.9 | 53.3 58.4 | 0.7 1.1 | 10.9 13.6 | 0.20 0.9 | 0.0 0.01 | 0.01 0.5 | 0.1 0.5 |
| Dietz 1 bed (7 analyses) | | | | | | | | | | | | |
| 22.5 24.8 | 32.4 34.4 | 39.2 40.4 | 2.8 3.9 | 9,568 9,954 | 3.9 4.1 | 55.1 56.5 | .09 1.0 | 12.1 13.1 | 0.2 0.6 | 0.0 0.01 | 0.01 0.1 | 0.1 0.3 |
| Dietz 2 bed (2 analyses) | | | | | | | | | | | | |
| 23.6 27.8 | 30.6 31.0 | 39.2 40.7 | 3.9 5.2 | 8,880 9,444 | 3.6 3.7 | 53.4 54.9 | 0.9 1.2 | 11.6 12.1 | 0.3 0.6 | 0.0 0.01 | 0.03 0.04 | 0.2 0.3 |

Table 8-5.--Analyses of tippie samples of coal from the Anderson-Dietz 1 coal bed, Decker Mine, Decker, Montana, collected during a 6-day period in 1973
[Swanson, V. E., Huffman, C., and Hamilton, J. C., 1974]

| A.--Quantitative determinations (in ppm) for 12 trace elements [Values for Cd, Cu, Li, Pb, and Zn are calculated from analyses on ash of coal] | | | | | | | | | | | | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----|-------|-----|----|-------|-----|-----|-----|-----|------|-----|-----|---------------|
| Sample No. | As | Cd | Cu | F | Hg | Li | Pb | Sb | Se | Th | U | Zn | Ash (percent) |
| D161317 | 3 | <0.05 | 8.6 | -- | 0.103 | 4.4 | 2.3 | --- | 0.4 | <1.5 | 0.6 | 3.8 | 4.76 |
| D161318 | 4 | <.05 | 8.2 | 50 | .108 | 4.4 | 2.4 | 0.3 | .6 | <1.5 | .6 | 4.5 | 4.89 |
| D161319 | 5 | <.05 | 9.2 | -- | .110 | 5.3 | 2.6 | -- | .9 | <1.5 | .8 | 5.8 | 5.36 |

| B.--Semi-quantitative spectrographic analyses (in ppm) for 19 trace elements [All values have been calculated from analyses on ash of coal] | | | | | | | | | | | | | | | | | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|------|-----|----|-----|----|----|-----|-----|----|-----|------|-----|-----|----|---|------|----|
| Sample No. | B | Ba | Be | Co | Cr | Ga | La | Mn | Mo | Nb | Ni | Sc | Sn | Sr | Ti | V | Y | Yb | Zr |
| D161317 | 30 | 500 | 0.15 | 0.7 | 3 | 1.5 | 3 | 7 | 1.5 | 1. | 3. | 1.5 | <0.5 | 300 | 300 | 10 | 3 | 0.15 | 10 |
| D161318 | 30 | 500 | .15 | 1. | 3 | 1.5 | 3 | 15 | 1.5 | <1. | 3. | 1.5 | <.5 | 300 | 300 | 15 | 3 | .15 | 10 |
| D161319 | 30 | 500 | .15 | 1. | 3 | 1.5 | 3 | 10 | 1.5 | <1. | 3. | 1.5 | <.5 | 300 | 300 | 10 | 3 | .15 | 10 |

| C.--Major-oxide composition (in percent) of the laboratory ash | | | | | | | | | | |
|----------------------------------------------------------------|------|------------------|--------------------------------|-------------------|------------------|-----|------|-------------------------------|--------------------------------|-----------------|
| Sample No. | Ash | SiO ₂ | Al ₂ O ₃ | Na ₂ O | K ₂ O | CaO | MgO | P ₂ O ₅ | Fe ₂ O ₃ | SO ₃ |
| D161317 | 4.76 | 25. | 16. | 6.90 | 0.5 | 14. | 2.70 | 1.1 | 7.1 | 20. |
| D161318 | 4.89 | 25. | 15. | 6.70 | .5 | 14. | 2.65 | 1.2 | 8.1 | 20. |
| D161319 | 5.36 | 26. | 15. | 6.10 | .6 | 13. | 2.30 | 1.3 | 8.3 | 21. |

D.--Proximate, ultimate, Btu, and sulfur analyses
[All analyses, except Btu, in percent; original moisture content may be slightly more than shown because samples were collected and transported in plastic bags to avoid metal contamination; AR, as received, and MAF, moisture and ash free; analyses by Coal Analysis Section, U.S. Bureau of Mines, Pittsburgh, Pennsylvania]

| Sample No. | USBM Lab. No. | Mois- ture | Vol. matter | Fixed C | Ash | Btu | Hydrogen | Carbon | Nitrogen | Oxygen | Sulfur | Sulfate S | Pyritic S | Organic S | | | | | | | | | | | |
|------------|---------------|------------|-------------|---------|------|------|----------|--------|----------|--------|--------|-----------|-----------|-----------|-----|------|------|-----|-----|------|------|------|------|------|------|
| D161318 | K-19971 | 20.6 | 31.6 | 42.0 | 43.4 | 58.0 | 4.4 | 9,880 | 13,160 | 6.2 | 5.2 | 57.1 | 76.0 | 0.9 | 1.2 | 30.9 | 17.0 | 0.5 | 0.6 | 0.01 | 0.01 | 0.20 | 0.26 | 0.26 | 0.35 |

Soil series and soil phases mapped in the Decker area

ANKO SERIES

This series consists of deep well-drained soils formed in loamy alluvium on fans and terraces. Typically these soils have a thin light brownish gray surface columnar clay loam subsoils and loam substratum with segregated lime and gypsum.

Typical Profile of Anko clay loam, in Sec. 16 about 750 feet east and 100 feet south of NW corner.

A₂ 0-2" Light gray (2.5y7/2 when dry) loamy fine sand; grayish brown (2.5y5/2 when moist); vesicular massive; soft when dry; very friable when moist.

B_{21t} 2-6" Grayish brown (2.5y when dry) heavy clay loam in upper 2 inches clay loam in lower 2 inches; dark grayish brown (2.5y4/2 when moist); strong medium and coarse columnar structure separating to moderate fine blocks; extremely hard when dry; firm when moist; sticky and plastic when wet.

B_{22t} 6-12" Light olive brown (2.5y5/3 when dry) heavy loam or sandy clay loam; dark olive brown (2.5y4/3 when moist); strong medium prismatic structure separating to weak medium subangular blocks; extremely hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; weak effervescence with a few masses of lime and gypsum.

B_{3cacs} 12-20" Light yellowish brown (2.5y6/3 when dry) heavy loam; light olive brown (2.5y5/3 when moist); weak coarse prismatic structure separating to moderate medium and coarse blocks; very hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence with a few soft masses and threads of lime and gypsum.

(Anko Series cont.)

C₁cacs 20-36" Light yellowish brown (2.5y6/3 when dry) loam; light olive brown (2.5y5/3 when moist); massive; very hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence with common soft masses of lime and a few seams and masses of gypsum.

C₂cs 36-66" Light yellowish brown (2.5y6/3 when dry) loam, silt loam, and light clay loam stratified; light olive brown (2.5y5/3 when moist); hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence; few threads and masses of gypsum.

Range in Characteristics: The A horizons are less than 4 inches thick. The B_{2t} horizons are clay loam, or sandy clay loam with 25 to 35 percent clay. The columnar structure is 2 to 6 inches thick. The C horizons are loam, sandy clay loam and fine sandy loam. Depth to bedrock is 48 inches to more than 8 feet.

ANKO SERIES BEDROCK SUBSTRATUM

This series is a member of a fine, loamy, mixed, mesic family of Ustollic Natrargids. Typically these soils have a one inch light gray vesicular sandy loam A₂ horizon; columnar blocky clay loam B_{2t} horizon, blocky clay loam B_{3ca} horizon with segregated lime and gypsum and clay loam C horizons underlain by siltstone within 40 inches.

Typical Profile Anko sandy clay loam, bedrock substratum in Sec. 21 T9S R40E near N $\frac{1}{4}$ corner.

A₂ 0-1" Pale brown (10yr6/3 when dry) light fine sandy loam; dark brown (10y4/3 when moist); vesicular massive crust; soft when dry; very friable when moist; nonsticky and nonplastic when wet.

B_{21t} 1-3" Light yellowish brown (10yr5/4 when dry) light sandy clay; dark yellowish brown (10yr4/4 when moist); strong fine and medium columnar structure; extremely hard when dry; firm when moist; sticky and plastic when wet; thick clay films.

B_{22t} 3-7" Light yellowish brown (10yr5/4 when dry) heavy sandy clay loam; dark yellowish brown (10yr4/4 when moist); strong medium prismatic structure separating to strong medium prismatic structure separating to strong fine and medium blocks; extremely hard when dry; friable when moist; sticky and plastic when wet; very weak effervescence.

B_{23t} 7-10" Light yellowish brown (10yr5/4 when dry) clay loam;
ca dark yellowish brown (10yr4/4 when moist); strong fine and medium prismatic structure separating to strong fine and medium blocks; extremely hard when dry; friable when moist; sticky and plastic when wet; weak effervescence with a few soft masses of lime.

(Anko Series cont.)

- B₃cacs 10-42" Light olive brown (2.5y5/4 when dry) clay loam;
olive brown (2.5y4/4 when moist); strong medium prismatic
structure separating to strong medium blocks; extremely
hard when dry; friable when moist; sticky and plastic when
wet; strong effervescence with common soft masses of lime
and a few seams and nests of gypsum.
- C₁ 24-42" Grayish brown (2.5y5/2 when dry) silty clay loam;
dark grayish brown (2.5y4/2 when moist); massive; extremely
hard when dry; friable when moist; sticky and plastic when
wet; strong effervescence with few soft masses of lime;
common seams and nests of gypsum.
- C₂ 42-54" Weakly consolidated siltstone weathered in upper 4".

Range in Characteristics: The A horizons are less than 4 inches thick. The B₂t horizon is clay loam or sandy clay loam and have columnar blocky, prismatic blocky, or blocky structure. Depth to segregated lime is 4 to 8 inches. Depth to bedrock is 30 to 44 inches.

COLBAR SERIES

This series consists of deep, well-drained soils formed in silty alluvium on fans, footslopes, and terraces. Typically, these soils have brown calcareous silty clay loam surface and light yellowish brown calcareous silt loam substratum.

Typical profile of Colbar silt loam in Sec. 33, T8S, R40E
250 feet north and 750 feet west of SE corner in grainfield.

- A_{1p} 0-6" Brown (7.5yr5/4 when dry) heavy silt loam; dark brown(7.5yr3/4 when moist); moderate fine granular structure; slightly hard when dry; very friable when moist;slightly sticky and slightly plastic when wet; weak effervescence.
- A₁₂ 6-10" Brown (7.5yr5/4 when dry) heavy silt loam; brown (7.5yr4/4 when moist); weak medium prismatic structure separating to moderate fine and very fine subangular blocks; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; weak effervescence.
- C₁ 10-24" Pale brown (10yr6/4 when dry) heavy silt loam; brown (10yr5/3 when moist); weak coarse prismatic structure separating to weak medium subangular blocks, hard when dry very friable when moist; sticky and slightly plastic when wet; strong effervescence.
- C₂ 24-44" Light yellowish brown (2.5y6/3 when dry) heavy silt loam; light olive brown (2.5y5/3 when moist); massive; with thin lenses of light silt loam and light silty clay loam; hard when dry; very friable when moist; sticky and slightly plastic when wet; strong effervescence.

(Colbar Series Cont.)

C₃ 44-66" Light yellowish brown (2.5y6/3 when dry) silt loam; loam; light silty clay loam; and very fine sandy loam stratified; light olive brown (2.5y5/3 when moist); soft when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.

Range in Characteristics: The colors in upper 12 to 24" are in hues of 2.54 to 7.5yr and in 2.5 or 10yr hue in lower C. The upper 6-12 inches is calcareous or noncalcareous. Coarser stratification can occur at any depth below 30 inches. The upper 7 to 12 inches is noncalcareous and threads or a few masses of segregated lime are present in same profile. The 10 to 40 inch control section has 20 to 30 percent clay.

COLBAR SERIES

Classification: Ustic Torriorthent-fine-silty, mixed (calcareous) mesic family.

Location: Sec. 3 T9S R40E, 400 feet west and 250 feet south of N $\frac{1}{4}$ corner.

Profile Description: Colbar silty clay loam.

- A_{1p} 0-6" Brown (7.5yr5/2 when dry) light silty clay loam; dark brown (7.5yr4/2 when moist); weak fine and medium granular structure; slightly hard when dry; very friable when moist; slightly sticky and plastic when wet.
- A₁₂ 6-12" Brown (7.5yr5/2 when dry) heavy silt loam; dark brown (7.5yr4/2 when moist); weak medium prismatic structure separating to moderate very fine and fine subangular blocks; hard when dry; very friable when moist; slightly sticky and plastic when wet.
- C₁ 12-20" Light yellowish brown (2.5y6/3 when dry) heavy silt loam; olive brown (2.5y4/3 when moist); moderate medium prismatic structure; separating to moderate medium subangular blocks; hard when dry; very friable when moist; slightly sticky and plastic when wet; strong effervescence.
- C₂ 20-40" Light yellowish brown (2.5y6/3 when dry) heavy silt loam with a few thin strata of light silt loam; light olive brown (2.5y5/3 when moist); hard when dry; very friable when moist; slightly sticky and plastic when wet; strong effervescence.
- C₃ 40-54" Light yellowish brown (2.5y6/3 when dry) silt loam and very fine sandy loam stratified; light olive brown

(Colbar Series C₃ cont.)

(2.5y5/3 when moist); slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.

C₄ 54-66" Light yellowish brown (2.5y6/3 when dry) loam, very fine sandy loam, and fine sandy loam stratified; light olive brown(2.5y5/3 when dry); soft when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence.

CORKIM SERIES

This series consists of deep, well-drained soils formed in loamy alluvium on fans, footslopes, and terraces; Typically, these soils are grayish brown surface, paly brown prismatic loams subsoils and soam substratum with segregated lime in upper part.

Typical Profile of Corkim loam in Sec. 4 T9S R40E, 0.25 mile North and 750 feet West of E $\frac{1}{4}$ corner.

- A_p 0-7" Grayish brown (10yr5/2 when dry) light loam; dark grayish brown (10yr4/2 when moist); weak fine and very fine granular structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet.
- B₂ 7-14" Yellowish brown (10yr5/4 when dry) light loam; dark yellowish brown (10yr4/4 when moist); moderate medium and coarse prismatic structure; hard when dry; very friable when moist; nonsticky and nonplastic when wet; moderate effervescence.
- C_{1ca} 14-36" Light brownish gray (2.5y6/2 when dry) light loam; grayish brown (2.5y5/2 when moist); weak coarse prismatic in upper and massive in lower part; hard when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence with few to common soft masses of segregated lime.
- C₂ 36-54" Light brownish gray (2.5y6/2 when dry) loam and silt loam; grayish brown (2.5y5/2 when moist); stratified hard when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence.

(Corkim Series cont.)

C₃ 54-66" Loam and fine sandy loam stratified strong effervescence.

Range in Characteristics: The 10 to 40 inch control section has about 10 to 18 percent clay. The A horizon is calcareous in many profiles. The B₂ horizon is absent or less distinct in some profiles. Sandy loam will occur below 30 inches in places.

CORKIM SERIES

Classification: Ustollic Camborthid-coarse-loamy, mixed, mesic.

Location: Sec. 15 T9S R40E 600 feet west and 400 feet south of
center of section.

Profile Description: Corkim loam.

- A₁ 0-3" Grayish brown (2.5y5/2 when dry) light loam; dark grayish brown (2.5y4/2 when moist); weak fine granular structure; soft when dry; very friable when moist; non-sticky and slightly plastic when wet.
- B₂ 3-12" Light olive brown (2.5y5/4 when dry) light loam; olive brown (2.5y4/4 when moist); moderate medium prismatic structure; slightly hard when dry; very friable when moist; nonsticky and slightly plastic when wet; weak effervescence.
- C_{1ca} 12-24" Light yellowish brown (2.5y6/3 when dry) light loam ; light olive brown (2.5y5/3 when moist); weak coarse prismatic in upper and massive in lower part; slightly hard when dry; very friable when moist; nonsticky and slightly plastic when wet; moderate effervescence; few fine seams of lime.
- C_{21a} 24-38" Light yellowish brown(2.5y6/3 when dry) light olive brown (2.5y5/3 when moist); massive; slightly hard when dry; very friable when moist; nonsticky and slightly plastic when wet; strong effervescence; few soft masses and threads of segregated lime.
- C₃ 38-84" Light yellowish brown (2.5y6/3 when dry) light loam with a few thin strata of fine sandy loam; light olive brown (2.5y5/3 when moist); slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence; a few soft masses of lime in upper part.

HAVERSON SERIES

This series consists of deep, well-drained soils formed in stratified alluvium on the bottomlands and flood plains. Typically, these soils have calcareous loam surface and upper substratum and stratified lower substratum.

Typical Profile of Haverson loam along Deer Creek in Sec.7
T9S R40E in grain stubble field.

- A_p 0-6" Light brownish gray (2.5y6/2 when dry) loam;
dark grayish brown (2.5y4/2 when moist); weak fine
and medium granular structure slightly hard when
dry, very friable when moist; slightly sticky and
slightly plastic when wet; moderate effervescence.
- C₁ 6-20" Light yellowish brown (2.5y6/3 when dry) light
loam; light olive brown (2.5y5/3 when moist); massive;
slightly hard when dry; very friable when moist;
slightly sticky and slightly plastic when wet;
moderate effervescence.
- C₂ 20-66" Light yellowish brown (2.5y6/3 when dry) loam;
fine sandy loam and light silt loam stratified; light
olive brown (2.5y5/3 when moist); moderate effervescence.

Range in Characteristics: Texture of upper 6 to 12 inches
is loam, silt loam, or clay loam. The degree, texture and thickness of stratification varies considerably.

HAVERSON SERIES

Classification: Ustic Torrifluvent-coarse-loamy, mixed (calcareous), mesic family.

Location: Sec. 15 T9S R40E 600 feet west and 1200 feet south of center of section.

Profile Description: Haverson clay loam.

- A₁ 0-12" Grayish brown (2.5y5/2 when dry) light silty clay loam: dark grayish brown (2.5y4/2 when moist); moderate effervescence.
- C₁ 12-20" Light yellowish brown (2.5y6/3 when dry) loam; light olive brown (2.5y5/3 when moist); massive; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; moderate effervescence.
- C₂ 20-66" Thinly stratified light loam; fine sandy loam; silt loam; and loamy fine sand.

HELDON SERIES

This series consists of deep well drained soils formed in alluvium on fans and terraces. Typically these soils have a silty clay surface and subsoil underlain by stratified loamy sediments below 20 inches.

Typical Profile of Heldon silty clay in Sec. 3 T9S R40E about 750 feet east of SW corner.

- A₁ 0-3" Grayish brown (2.5y5/2 when dry) silty clay; dark grayish brown (2.5y4/2 when moist); strong very fine and fine granular structure; extremely hard when dry; friable when moist; sticky and plastic when wet; very weak effervescence.
- B₂ 3-18" Grayish brown (2.5y5/2 when dry) silty clay; dark grayish brown (2.5y4/2 when moist); moderate fine and medium blocky structure; extremely hard when dry; firm when moist; sticky and plastic when wet; very weak effervescence.
- C₂ 18-24" Light yellowish brown (2.5y6/3 when dry) heavy silty clay loam; light olive brown (2.5y5/3 when moist); massive; very hard when dry; friable when moist; sticky and plastic when wet; strong effervescence.
- IIC₃ 24-32" Light yellowish brown (2.5y6/3 when dry); light clay loam and silty clay loam stratified; light olive brown (2.5y5/3 when moist); very hard when dry; friable when moist; sticky and plastic when wet; strong effervescence.

- IIC₄ 32-58" Light yellowish brown (2.5y6/3 when dry) loam
 light olive brown (2.5y5/3 when moist).
- IIC₅ 58-66" Loam and fine sandy loam stratified.

Range in characteristics: Thickness of clay is 16 to 24 inches. Texture of underlying materials is loam, silt loam, and fine sandy loam stratified.

HYSHAM SERIES

This series is a member of a fine-loamy, mixed (calcareous) Mesic family of Ustic Torriorthents. Typically these soils have a thin gray A horizon, blocky or massive upper C horizon and stratified lower horizon.

Typifying Pedon: Hysham clay loam on 4% slope in Sec. 21 T9S R40E near W $\frac{1}{4}$ corner.

- A₁ 0-1" Light gray (2.5y7/2 when dry) loam; grayish brown; (2.5y5/2 when moist); vesicular massive; soft when dry; very friable when moist; nonsticky and nonplastic when wet.
- C₁ 1-8" Light yellowish brown (2.5y6/3 when dry) light clay loam; light olive brown (2.5y5/3 when moist); weak medium and coarse blocky structure; extremely hard when dry; very friable when moist; slightly sticky, and slightly plastic when wet; moderate effervescence.
- C₂ 8-14" Light yellowish brown (2.5y6/3 when dry) light clay loam; light olive brown (2.5y5/3 when moist); weak meium and coarse blocky structure; extremely hard when dry; friable when moist; sticky and plastic when wet; strong effervescence; few soft masses of lime.
- C₂cs 14-40" Light yellowish brown (2.5y6/3 when dry) loam; silt loam, very fine sandy loam, light clay loam and light silty clay loam stratified; light olive brown

(Hysham Series C₂cs cont.)

(2.5y5/3 when moist); extremely hard when dry; friable when moist; slightly sticky and slightly plastic when wet; strong effervescence; few threads of gypsum.

C₄ 40-66" Light yellowish brown (2.5y6/3 when dry) loam stratified with silt loam, light clay loam and light silty clay loam and fine sandy loam; light olive brown (2.5y5/3 when moist); extremely hard when dry; friable and very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.

Range in Characteristics: Texture of A horizon is loam or clay loam. The 10 to 40 inch control section has 18 to 30 percent clay with considerable stratification. Indistinct columnar structure is present in some profiles.

KEISER SERIES

This series consists of deep well-drained soils formed in silty alluvium on fans and terraces. Typically those soils have a very thin light brownish gray surface layer, brown blocky light silty clay subsoils and calcareous silt loam substratum.

Typical profile of Keiser silty clay loam in Sec. 17 T9S R40E NESW.

- A₁ 0-1" Light brownish gray (10yr6/2 when dry) loam dark grayish brown (10yr4/2 when moist); moderate fine platy; soft when dry; very friable when moist; slightly sticky and slightly plastic when wet; many unstained sand grains.
- B₁ 1-4" Brown (10yr5/3 when dry) light silty clay loam; dark brown (10yr4/3 when moist); moderate fine and medium prismatic structure separating to strong fine blocks; very hard when dry; friable when moist; sticky and plastic when wet.
- B_{21t} 4-9" Brown (10yr5/3 when dry) light silty clay; dark brown (10yr4/3 when moist); moderate fine and medium prismatic structure separating easily to strong fine blocks; very hard when dry; friable when moist; sticky and very plastic when wet.
- B₃₁ 9-12" Brown (10yr5/3 when dry) silty clay loam; dark brown (10yr4/3 when moist); moderate medium prismatic structure separating easily to strong fine and medium blocks; very hard when dry; friable when moist; sticky and plastic when wet; weak effervescence.

(Keiser Series cont.)

B₃₂ca 12-18" Pale brown (10yr6/3 when dry) light silty clay loam; dark brown (10yr4/3 when moist); moderate medium prismatic structure separating to moderate medium blocks; very hard when dry; friable when moist; slightly sticky and slightly plastic when wet; strong effervescence with a few soft masses of segregated lime.

C₁ca 18-42" Light yellowish brown (2.5y6/3 when dry) heavy silt loam and light silty clay loam; olive brown (2.5y4/3 when moist); massive; hard when dry very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence with a few soft masses of segregated lime.

C₂ 42-66" Light yellowish brown (2.5y6/3 when dry) heavy silt loam and light silty clay loam stratified; olive brown (2.5y4/3 when moist); massive; hard when dry; very friable when moist; sticky and plastic when wet; strong effervescence.

Range in Characteristics: The depth to segregated lime is 7-11 inches. The B_{2t} is silty clay loam or silty clay with 34 to 45 percent clay. The horizons are silt loam, loam, clay loam or silty clay loam with 24 to 30 percent clay between 10 and 40 inches. Horizon may be coarser textured below 42 inches and may have a few fine scoria fragments.

KEISER SERIES

Classification: Ustollic Haplargid-fine-silty, mixed, mesic family

Location: Sec 1 T9S R40E about 800 feet south of center of section

Profile Description: Keiser silty clay loam.

A_p 0-5" Grayish brown (10yr5/3 when dry) silty clay loam; brown (10yr4/3 when moist); strong fine and very fine granular structure; hard when dry; very friable when moist; slightly sticky and plastic when wet.

B_{21t} 5-8" Brown (10yr5/3 when dry) heavy silty clay loam; dark brown (10yr4/3 when moist); strong fine and medium prismatic structure separating to strong fine and medium blocks; very hard when dry; friable when moist; sticky and plastic when wet.

B_{22t} 8-10" Brown (10yr5/3 when dry) silty clay loam; dark brown (10yr4/3 when moist); strong medium bolcks; very hard when dry; friable when moist; sticky and plastic when wet; moderate effervescence.

B_{32ca} 10-20" Pale brown (10yr6/3 when dry) light silty clay loam; dark brown (10yr4/3 fwhen moist); strong medium prismatic structure separating to moderate medium blocks; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence; few soft masses of segregated lime.

C_{1ca} 20-34" Light yellowish brown (2.5y6/3 when dry) light silty clay loam or heavy silt loam; light olive brown (2.5y5/3 when dry); weak coarse prismatic in upper and massive in lower part; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence; common soft masses of segregated lime.

(Keiser Series cont.)

- C₂ 34-50" Light yellowish brown (2.5y6/3 when dry) silt loam with a few silty clay loam strata; light olive brown (2.5y5/3 when moist); hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.
- C₃ 50-66" Light yellowish brown (2.5y6/3 when dry) silt loam; loam; and fine sandy loam stratified; light olive brown (2.5y5/3 when moist); strong effervescence.

KIM SERIES

This series consists of deep, well drained soils formed in stratified loamy alluvium on fans and footslopes. Typically, these soils have a loam surface and stratified loam and clay loam substratum.

Typical Profile of Kim loam in Sec. 9 T9S R40E just east of N $\frac{1}{4}$ corner.

- A₁ 0-3" Grayish brown (2.5y5/2 when dry) loam; dark grayish brown (2.5y4/2 when moist); weak fine and medium platy structure; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; weak effervescence.
- C₁ 3-8" Grayish brown (2.5y5/2 when dry) heavy loam; dark grayish brown (2.5y4/2 when moist); massive; hard when dry; very friable when moist; sticky and slightly plastic when wet; strong effervescence.
- C₂ 8-14" Grayish brown (2.5y5/2 when dry) loam and fine sandy loam stratified; dark grayish brown (2.5y4/2 when moist); hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.
- C_{3ca} 14-26" Grayish brown (2.5y5/2 when dry) sandy clay loam and loam stratified; dark grayish brown (2.5y4/2 when moist); extremely hard when dry; friable when moist; slightly sticky and slightly plastic when wet; strong effervescence with a few seams and soft masses of segregated lime.

(Kim Series cont.)

C₄ca 26-38" Light yellowish brown (2.5y6/3 when dry) loam; clay loam; and sandy clay loam stratified; light olive brown (2.5y5/3 when moist); extremely hard when dry; friable when moist; slightly sticky and slightly plastic when wet; strong effervescence with a few soft masses of segregated lime.

C₅ 38-62" Light yellowish brown (2.5y6/3 when dry) loam and sandy clay loam stratified; light olive brown (2.5y5/2 when moist); extremely hard when dry; friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.

C₆ 62-70" Fine sandy loam.

Range in Characteristics: The texture of 10 to 40 inches control section is loam with 20 to 30 percent clay. The horizon of segregated lime is not always present.

McRAE SERIES

This series consists of deep, well-drained soils formed in loam alluvium on fans and terraces. Typically these soils have grayish brown loam surface, light olive brown prismatic loam subsoils, and light yellowish brown calcareous loam substratum.

Typical Profile of McRae loam in Sec. 8 T9S R40E about 400 feet north and 600 feet west of SE corner.

- A₁ 0-3" Grayish brown (2.5y5/2 when dry) loam; dark grayish brown (2.5y4/2 when moist); moderate fine platy structure separating to moderate fine granules; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet.
- B₂ 3-12" Light olive brown (2.5y5/4 when dry) heavy loam; olive brown (2.5y4/4 when moist); moderate medium prismatic structure; separating to weak medium and coarse blocks; hard when dry; very friable when moist; slightly sticky and plastic when wet; weak effervescence in upper and moderate effervescence in lower part.
- B_{3ca} 12-18" Light yellowish brown (2.5y6/3 when dry) heavy loam; light olive brown (2.5y5/3 when moist); moderate coarse prismatic structure; hard when dry; very friable when moist; sticky and plastic when wet; strong effervescence; few soft masses of segregated lime.

C_{1ca} 18-30" Pale olive (5y6/3 when dry) heavy loam; olive (5y5/3 when moist); massive with some stratification in lower part; hard when dry; very friable when moist; slightly sticky and plastic when wet; strong effervescence; few soft masses and threads of segregated lime.

C₂ 30-66" Pale olive (5y6/3 when dry) loam; clay loam and silt loam stratified; olive (5y5/3 when moist); hard when dry; very friable when moist; strong effervescence.

Range in Characteristics: The 10 to 40 inch control section averages a loam with 18 to 25 percent clay. The A horizon is calcareous in places and the B₂ horizon is less distinct in some profiles.

MIDWAY SERIES

This series consists of shallow soils formed in clayey materials weathered from claystone or shales. Typically these soils have light yellowish brown heavy silty clay loam surface and substratum underlain by weakly consolidated bedrock within a depth of 20 inches.

Typical Profile of Midway silty clay loam in Sec. 13
T9S R40E in SE $\frac{1}{4}$.

A₁ 0-2" Light olive gray (5y6/2 when dry) silty clay loam; olive gray (5y5/2 when moist); strong fine and very fine granular structure; hard when dry; very friable when moist; sticky and plastic when wet; moderate effervescence.

C₁ 2-14" Pale olive (5y6/3 when dry) heavy silty clay loam; olive (5y5/3 when moist); weak coarse prismatic structure; very hard when dry; friable when moist; very sticky and plastic when wet; few fine shale chips and weakly expressed platy structure in lower parts; strong effervescence; few soft masses of segregated lime.

C₂ 14-30" Weakly consolidated platy clay stone.

Range in Characteristics: Depth to the bedrock is 4 to 20 inches. Texture of regolith is silty clay loam or silty clay with 35 to 45 percent clay. Colors are in hues of 5y through 7.5yr. Segregated gypsum occurs in many profiles just above bedrock.

The Midway soils are associated with the shingle soils mainly.

NELAR SERIES

This series consists of deep, well-drained soils formed in red colored loamy alluvium on fans and footslopes. Typically, these soils have reddish brown light loam surface, light reddish brown calcareous light loam upper substratum and stratified lower substratum.

Typical Profile of Nelar loam in Sec. 10 T9S R40E, 1000 feet south and 1100 feet west of NE corner; just north of angle fence.

- A₁₁ 0-4" Reddish brown (5yr5/3 when dry) light loam; dark reddish brown (5yr3/3 when moist); weak fine granular structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet; few fine angular scoria fragments.
- A₁₂ 4-10" Reddish brown (5yr5/4 when dry) light loam; dark reddish brown (5yr3/3 when moist); weak fine and medium subangular blocky structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet; weak effervescence.
- C_{1ca} 10-42" Light reddish brown (5yr6/4 when dry) light loam; reddish brown (5yr4/4 when moist); weak coarse prismatic structure in upper and massive in lower part; slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet; few small lime-coated angular scoria and sandstone fragments; very strong effervescence; few fine threads of lime.

(Nelar Series cont.)

C₂ 42-66" Red (2.5yr5/5 when dry) light loam and fine sandy loam; reddish brown (2.5yr4/4 when moist); massive; soft when dry; very friable when moist; nonsticky and nonplastic when wet; about 5 percent by volume of fine angular sandstone and scoria fragments.

Range in Characteristics: The texture of 10 to 40 inch control section is loam or fine sandy loam with less than 12 percent clay and less than 15 percent by volume of angular fragments. The sandy loam substratum can occur at any depth below 30 inches. A very weakly expressed B₂ horizon is present in some profiles.

Colors are in hues redder than 7.5yr.

NELAR SERIES

Classification: Entic Haplustoll-coarse-loamy, mixed, mesic family.

Location: Sec. 11 T9S R40E 400 feet north and 150 feet east of W $\frac{1}{4}$ corner in road cut.

Profile Description: Nelar loam.

A₁ 0-8" Reddish brown (5yr4/4 when dry) light loam; dark reddish brown (5yr3/4 when moist); moderate fine and very fine granular structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet; few flat fragments.

C_{1ca} 8-36" Light reddish brown (5yr6/3 when dry) light loam; reddish brown (5yr4/3 when moist); weak coarse prismatic structure; slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet; very strong effervescence with a few threads of lime; few lime coated angular fragments.

C₂ 36-80" Reddish brown (5yr5/4 when dry) light loam and fine sandy loam; reddish brown (5yr4/4 when moist); massive; soft when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence; few lime coated angular fragments.

Range in Characteristics: The texture of control section is loam or sandy loam with less than 12 percent clay and less than 15 percent by volume of angular fragments. Bedrock is typically deeper than 5 feet but can occur above this depth in some profiles. The sandy loam substratum can occur at any depth below 30 inches. In places a very weakly expressed B₂ horizon is present.

Colors are in hues redder than 7.5yr.

NELSON SERIES

This series consists of moderately deep soils formed in sandy loam residuum on sedimentary uplands. Typically, these soils have brown fine sandy loam A horizon and yellowish brown calcareous fine sandy loam C horizons underlain by weakly consolidated sandstone at about 30 inches.

Typical Profile of Nelson fine sandy loam in Section 21
T9S R40E.

- A₁₁ 0-4" Brown (10yr5/3 when dry) fine sandy loam; dark brown (10yr4/3 when moist); single-grain structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet;
- A₁₂ 4-10" Yellowish brown (10yr5/4 when dry) fine sandy loam; dark yellowish brown (10yr4/4 when moist); weak coarse prismatic structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet.
- C₁ 10-24" Light yellowish brown (10yr6/4 when dry) fine sandy loam; yellowish brown (10yr5/5 when moist); weak coarse prismatic structure in upper part and massive in lower part; slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence with a few soft masses of segregated lime in upper part; few fragments of soft sandstone in lower few inches.
- C₂ 24-40" Strongly calcareous; weakly consolidated sandstone.

(NELSON Series cont.)

Range in Characteristics: Depth to weakly consolidated sandstone is 20 to 32 inches. The A horizon has weak effervescence in many profiles. More consolidated sandstone underlays these soils in places.

NEVEE SERIES

This series consists of deep well-drained soils formed in red colored silty alluvium on fans and terraces. Typically, these soils have reddish brown calcareous silt loam surface and substratum.

Typical Profile of Nevee silt loam in Sec. 4 T9S R40E
about 1750 feet west and 500 feet south of NE corner

- A_p 0-7" Reddish brown (5yr5/4 when dry) light silt loam; dark reddish brown (5yr3/4 when moist); weak fine granular structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet; weak effervescence.
- C₁ 7-20" Light reddish brown (5yr6/4 when dry) light silt loam; reddish brown (5yr5/4 when moist) weak medium prismatic structure; slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence.
- C₂ 20-3-" Light reddish brown (5yr6/4 when dry) light silt loam; reddish brown (5yr4/4 when moist); massive; slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence.
- C₃ 30-66" Reddish brown (5yr5/4 when dry) light silt loam with thin stratifications of very fine sandy loam; soft when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence.

(Nevee Series cont.)

Range in Characteristics: the A horizon has colors with values of 5 or 6 dry and 3 or 4 moist and chroma of 4 or 5 in hues of 7.5yr and redder. The horizons have 10 to 12 percent clay, and have colors in hues of 5yr and redder. Stratification occurs at any depth below 20 inches. A few threads or masses of segregated lime are present in some profiles.

A few fine angular sandstone or porcelanite fragments are present in some profiles.

NEVILLE SERIES

This series consists of deep well-drained soils formed in reddish colored, loamy alluvium on fans and terraces. Typically, these soils have reddish brown loam surface and reddish brown stratified loam substratum.

Typical Profile of Neville loam in Sec. 3 T9S R40E about 1000 feet north and 500 feet east of center of section.

- A_p 0-7" Reddish brown (5yr5/3 when dry) loam; reddish brown (5yr4/3 when moist); moderate fine granular structure; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; weak effervescence.
- C₁ 7-24" Light reddish brown (5yr6/3 when dry) heavy loam; reddish brown (5yr4/3 when moist); massive; hard when dry, very friable when moist; slightly sticky and slightly plastic when wet; moderate effervescence.
- C₂ 24-66" Light reddish brown (5yr6/4 when dry) heavy loam with thin silt loam and fine sandy loam strata reddish brown (5yr5/3 when moist); strong effervescence.

Range in Characteristics: Colors are in hues redder than 7.5yr. Texture of 10 to 40 inch control section is loam or light clay loam with 18 to 30 percent clay. A few flat angular scoria or sandstone fragments are present in some profiles.

OKAR SERIES

This series consists of deep, well drained soils formed in alluvium on fans and terraces. Typically these soils have very thin light gray surface layer, clayey subsoils that are columnar in upper part and blocky prismatic in lower part; and silty clay loam substratum with segregated lime and gypsum.

Typical Profile of Okar silty clay loam in Section 17 T9S R40E about 1000 feet south of N $\frac{1}{4}$ corner:

- A₂ 0-2" Light gray (2.5y 7/2 when dry) light very fine sandy loam; dark grayish brown (2.5y 4/2 when dry); vesicular massive in upper 1" and moderate very thin and thin platy in lower part; soft when dry, very friable when moist, nonsticky and nonplastic when wet.
- B_{21t} 2-7" Grayish brown (2.5y 5/3 with 4/2 coats when dry) silty clay; dark grayish brown (2.5y 4/3 with 3/2 coats when moist); strong fine and medium columnar structure separating to moderate medium and coarse blocks; extremely hard when dry; firm when moist; sticky and plastic when wet.
- B_{22t} 7-12" Light olive brown (2.5y 5/4 when dry) light silty clay; olive brown (2.5y 4/4 when moist); strong medium prismatic structure separating to moderate fine and medium blocks; extremely hard when dry; firm when moist; sticky and plastic when wet; very weak effervescence.
- B_{3ca} 12-20" Light olive brown (2.5y 5/3 with 5/2 coats when dry) heavy silty clay loam; olive brown (2.5y 4/3 with 4/2 coats

when moist); strong medium prismatic structure separating to segments; extremely hard when dry, friable when moist, sticky and plastic when wet; strong effervescence with a few soft masses of segregated lime.

- C_{1ca} 20-36" Light yellowish brown (2.5y 6/3 when dry) light silty clay loam; light olive brown (2.5y 5/3 when moist); weak prismatic in upper and massive in lower part; very hard when dry; very friable when moist, slightly sticky and slightly plastic when wet, strong effervescence with a few soft masses of segregated lime.
- C₂ 36-44" Light yellowish brown (2.5y 6/3 when dry) light silty clay loam; light olive brown (2.5y 5/3 when moist); massive; very hard when dry, very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.
- C_{3cs} 44-54" Light yellowish brown (2.5y 6/3 when dry) light silty clay loam, light olive brown (2.5y 5/3 when moist) massive; very hard when dry; very friable when moist, slightly sticky and slightly plastic when wet; strong effervescence; few fine threads of gypsum.
- C₄ 54-66" Light yellowish brown (2.5y 6/3 when dry) silt loam with thin strata of loam and light silty clay loam; light olive brown (2.5y 5/3 when moist); hard when dry, very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence; few threads of gypsum in upper part.

Range in Characteristics: The A horizons are less than 4 inches thick. The B_{2t} is silty clay loam or silty clay with 36 to 45 percent clay and have columnar, prismatic blocky or blocky structure. The C horizons are silty clay loam, loam, and siltloam which become stratified with coarser textured materials with depth.

OLNEY SERIES

This series consists of deep, well-drained soils formed in sandy loam alluvium on fans and terraces. Typically, these soils have a fine sandy loam surface, prismatic sandy clay subsoils and sandy loam substratum with segregated lime in upper part.

Typical Profile of Olney fine sandy loam in Sec. 16 T9S R40E about 650 feet south and 350 feet west of NE corner.

- A₁₁ 0-2" Light brownish gray (10yr6/2 when dry) fine sandy loam; dark grayish brown (10yr4/2 when moist); vesicular massive; soft when dry; very friable when moist; nonsticky and nonplastic when wet.
- A₃ 2-4" Brown (10yr5/3 when dry) heavy fine sandy loam; dark brown (10yr4/3 when moist); moderate medium prismatic separating to strong fine and medium plates; slightly hard when dry; very friable when moist; nonsticky and slightly plastic,
- B_{21t} 4-8" Brown (10yr5/3 when dry) sandy clay loam; dark brown (10yr4/3 when moist); strong medium and coarse prismatic structure separating to weak medium blocks; very hard when dry; friable when wet; slightly sticky and slightly plastic when wet.
- B_{22t} 8-16" Light yellowish brown (10yr5/4 when dry) light sandy clay loam; dark yellowish brown (10yr4/4 when moist); strong medium and coarse prismatic structure; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet.

(Olney Series cont.)

- B23t 16-20" Light yellowish brown (10yr5/4 when dry) heavy sandy loam; dark yellowish brown (10yr4/4 when moist); strong medium and coarse prismatic structure; hard when dry; very friable when moist; nonsticky and slightly plastic.
- B₃ca 20-3-" Light olive brown (2.5y5/4 when dry) heavy sandy loam; olive brown (2.5y4/4 when moist); moderate coarse prismatic structure; slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence with a few soft masses of segregated lime.
- C₁ca 30-50" Light yellowish brown (2.5y6/4 when dry) sandy loam; light olive brown (2.5y5/4 when moist); massive; soft when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence with a few soft masses and threads of segregated lime.
- C₂ 50-66" Light yellowish brown (2.5y6/4 when dry) sandy loam; light olive brown (2.5y5/4 when moist); massive; soft when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence.

OLNEY SERIES Deep over Bedrock

Classification: Ustollic Haplargid-fine-loamy, mixed, mesic family

Location: Sec. 15 T9S R40E, 1400 feet south and 200 feet east of NW corner, about 100 feet south of stockpile.

Profile Description: Olney fine sandy loam, deep over bedrock.

- A₁₁ 0-2" Light brownish gray (10yr6/2 when dry) fine sandy loam; dark grayish brown (10yr4/2 when moist); vesicular massive structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet; many unstained sand and silt sized grains.
- A₁₃ 2-4" Brown (10yr5/3 when dry) light loam; dark brown (10yr4/3 when moist); moderate medium prismatic structure separating to moderate fine and medium plates; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet.
- B_{21t} 4-12" Yellowish brown (10yr5/4 when dry) fine sandy clay loam; dark yellowish brown (10yr4/4 when moist); strong medium prismatic structure separating to moderate medium subangular blocks extremely hard when dry; friable when moist; sticky and plastic when wet.
- B_{22t} 12-17" Brown (10yr5/3 when dry) light fine sandy clay loam; dark brown (10yr4/3 when moist); strong medium prismatic structure; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet.
- B₃₁ 17-22" Brown (10yr5/3 when dry) heavy fine sandy loam; dark brown (10yr4/3 when moist); moderate medium and coarse prismatic structure; hard when dry; very friable when moist; nonsticky and slightly plastic when wet.

(Olney Series cont.)

B₃₂ca 22-30" Light yellowish brown (2.5y6/3 when dry) heavy fine sandy loam; olive brown (2.5y4/3 when moist); moderate medium and coarse prismatic structure; hard when dry; very friable when moist; nonsticky and slightly plastic when wet; strong effervescence with a few soft masses of segregated lime.

C₁ca 36-48" Olive yellow (2.5y6/5 when dry) light fine sandy clay loam; light olive brown (2.5y5/5 when moist); slightly sticky and slightly plastic when wet; massive; hard when dry; very friable when moist; strong effervescence; common soft masses of segregated lime; few fragments of soft sandstone in lower part.

IIC₂ 48-66" Weakly consolidated sandstone.

REDBY SERIES

This series consists of deep, well-drained soils formed in red colored silty alluvium on fans. Typically, these soils have reddish brown calcareous surface and substratum.

Typical Profile of Redby silt loam in Sec. 33 T9S, R40E

750 feet north and 1000 feet west of E $\frac{1}{4}$ corner.

- A_p 0-6" Reddish brown (5yr5/4 when dry) silt loam; dark reddish brown (5yr3/4 when moist); weak fine granular structure; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; weak effervescence.
- C₁ 6-10" Reddish brown (5yr5/4 when dry and 4/4 when moist) silt loam; moderate medium prismatic structure; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; weak effervescence.
- C₃ 10-20" Reddish brown (5yr5/4 when dry and 4/4 when moist) silt loam; weak medium prismatic structure; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence with a few fine threads of lime.
- C₃ 20-44" Light reddish brown (5yr6/3 when dry) silt loam; reddish brown (5yr4/4 when moist); massive; slightly hard when dry; very friable when moist; slightly sticky, and slightly plastic when wet; strong effervescence.
- C₄ 44-66" Light reddish brown (5yr6/3 when dry) silt loam; loam, and very fine sandy loam stratified; slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence.

REDBY SERIES

This series consists of deep, well-drained soils formed in red colored silty alluvium on fans. Typically , these soils have reddish brown calcareous surface and substratum.

Typical Profile of Redby silt loam in Sec. 33 T9S, R40E
750 feet north and 1000 feet west of E $\frac{1}{4}$ corner.

- A_p 0-6" Reddish brown (5yr5/4 when dry) silt loam; dark reddish brown (5yr3/4 when moist); weak fine granular structure; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; weak effervescence.
- C₁ 6-10" Reddish brown (5yr5/4 when dry and 4/4 when moist) silt loam; moderate medium prismatic structure; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; weak effervescence.
- C₃ 10-20" Reddish brown (5yr5/4 when dry and 4/4 when moist) silt loam; weak medium prismatic structure; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence with a few fine threads of lime.
- C₃ 20-44" Light reddish brown (5yr6/3 when dry) silt loam; reddish brown (5yr4/4 when moist); massive; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.
- C₄ 44-66" Light reddish brown (5yr6/3 when dry) silt loam; loam, and very fine sandy loam stratified; slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence.

(Redby cont.)

Range in Characteristics: The colors are in hues redder than 7.5 yr. The 10 to 40 inch control section has 18 to 25 percent clay. Stratifications can occur at any depth below 30 inches. A few fine angular sandstone or porcelanite fragments are present in some profiles.

SHINGLE SERIES

This series consists of shallow soils formed in loamy materials weathered from weakly consolidated siltstone on the sedimentary bed-rock uplands. Typically these soils have light brownish gray silt loam surface and pale olive silt loam substratum underlain by weakly consolidated siltstone or loam stone within 20 inches.

Typical Profile of Shingle silt loam

- A₁ 0-2" Light brownish gray (2.5y6/2 when dry) silt loam; dark grayish brown (2.5y4/2 when moist); weak very fine granular structure; soft when dry very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.
- C₁ 2-18" Pale olive (5y6/3 when dry) silt loam; olive (5y5/3 when moist); massive; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.
- C₂ 18-20" Olive colored calcareous weakly consolidated platy siltstone.

Range in Characteristics: Depth to siltstone or loamstone is 4 to 20 inches. Texture of regolith is loam, silt loam or clay loam, with less than 35 percent clay. Soft masses of segregated lime or of gypsum are present in some profiles. Colors are in hues of 5y through 10yr.

The Shingle soils are associated with the Midway, Tassel, Travessilla and Wibaux soils.

SPERLIN SERIES

This series consists of deep, well-drained soils formed in red colored loamy alluvium on fans and fooslopes. Typically, these soils have reddish brown foam surface and light reddish brown calcareous loam substratum underlain by consolidated bedrock within 40 inches.

Typical Profile of Sperlin loam in Sec. 15, T9S R40E about 350 feet west and 125 feet south of NE corner.

- A₁₁ 0-2" Reddish brown (5yr5/4 when dry) light loam; dark reddish brown (5yr3/4 when moist); weak fine granular structure; slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet;
- A₁₂ 2-8" Reddish brown (5yr4/4 when dry) light loam; dark reddish brown (5yr3/4 when moist); weak medium and coarse prismatic structure separating to weak fine and medium subangular blocks; slightly hard when dry; very friable when moist; slightly sticky and nonplastic.
- C_{1ca} 8-15" Reddish brown (5yr5/4 when dry) light loam; reddish brown (5yr4/4 when moist); weak medium and coarse prismatic structure; separating to weak subangular blocks; slightly hard when dry; very friable when moist; slightly sticky and nonplastic when wet; very strong effervescence with a few seams of lime.
- C_{21a} 15-30" Light brown (7.5yr6/4 when dry) light loam; reddish brown (5yr5/4 when moist); massive; slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet; very strong effervescence; few weathered sandstone fragments.

(Sperlin Series kont.)

C₃ 30-34" Light brown (7.5yr6/4 when dry) fine sandy loam; reddish brown (5yr5/4 when moist); massive; soft when dry; very friable when moist; nonsticky and nonplastic when wet; very strong effervescence; few sandstone fragments.

IIR Hard sandstone.

Range in Characteristics: Depth to the lithic contact is 20 to 40 inches. Colors are in hues redder than 7.5 yr. The depth to lime is 2 to 8 inches. Coarse fragments are less than 15 percent. The lower part of control section is fine sandy loam or sandy loam.

SPERLIN SERIES

Classification:

Location: Sec. 10 T9S R40E 800 feet south and 800 feet east of NW corner.

Profile Description: Sperlin gravelly loam.

- A₁ 0-4" Reddish brown (5yr5/3 when dry) light loam; dark reddish brown (5yr3/3 when moist); weak fine granular structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet; 5 percent by volume fine angular sandstone and scoria fragments in mass but about 40 percent of surface covered by fragments.
- C₁ 4-20" Reddish brown (5yr5/4 when dry) light loam; reddish brown (5yr4/4 when moist); massive; soft when dry; very friable when moist; nonsticky and nonplastic when wet; about 5 percent lime coated angular fragments; strong effervescence.
- C₂ 20-38" Light reddish brown (5yr6/3 when dry) light loam or fine sandy loam; reddish brown (5yr4/4 when moist); massive soft when dry; very friable when moist; nonsticky and nonplastic when wet; about 10 percent by volume small lime coated angular sandstone fragments; strong effervescence.
- R 38"+ Hard, baked sandstone which is shattered in upper part.

STONEHAM SERIES

This series consists of deep, well-drained soils formed in loam alluvium on fans and terraces. Typically these soils have grayish brown loam surface, brown blocky prismatic clay loam subsoils and loam substratum with segregated lime in upper part.

Typifying Pedon Stoneham loam in Sec. 3 T9S R40E 600 feet north and 600 feet east of SW corner.

- A₁₁ 0-1" Light brownish gray (10yr6/2 when dry) loam; dark grayish brown (10yr4/2 when moist); vesicular crust with common unstained sand grains; soft when dry; very friable when moist; nonsticky and nonplastic when wet;
- A₁₂ 1-3" Grayish brown (10yr5/2 when dry) loam; dark grayish brown (10yr4/2 when moist); strong very fine and fine granular structure; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet.
- B_{21t} 3-9" Brown (10yr5/3 when dry) heavy clay loam; dark brown (10yr4/3 when moist); strong fine and medium prismatic structure separating easily to strong fine blocks; very hard when dry; friable when moist; sticky and plastic when wet.
- B_{22t} 9-11" Light yellowish brown (10yr6/4 when dry) clay loam; yellowish brown (10yr5/4 when moist); strong medium prismatic structure separating to moderate medium blocks very hard when dry; friable when moist; sticky and plasted when wet; weak effervescence.
- B_{3ca} 11-20" Light yellowish brown (10yr6/4 when dry) heavy loam; yellowish brown (10yr5/4 when moist); moderate medium

(Stoneham Series cont.)

prismatic structure separating to weak medium blocks;
hard when dry; very friable when moist; slightly sticky
and slightly plastic when wet; strong effervescence with
a few soft masses of lime.

C_{1ca} 20-32" Pale brown (10yr6/3 when dry) heavy loam; brown
(10yr5/3 when moist); massive; slightly hard when dry; very
friable when moist; slightly sticky and slightly plastic
when wet; strong effervescence with common soft masses
of lime.

C₂ 32-66" Pale brown (10yr6/3 when dry) loam and silt loam
stratified; brown (10yr5/3 when moist); hard when dry;
very friable when moist; slightly sticky and slightly
plastic when wet; strong effervescence.

Range in Characteristics: The noncalcareous solum is 7 to 12
inches thick. The B_{2t} horizon has 30 to 40 percent clay. The C
horizon is loam or light clay loam with about 24 to 30 percent clay.
Stratification of coarser materials commonly occur below 48 inches.

STONEHAM SERIES

Classification: Ustollic Haplargid-fine-loamy, mixed mesic family.

Location: Sec. 12 T9S R40E about 1200 feet south of center of section.

Profile Description: Stoneham loam

- A₁ 0-2" Grayish brown (10yr5/2 when dry) loam; dark brown (10yr4/3 when moist); strong very thin and thin platy structure; soft when dry; very friable when moist; slightly sticky and slightly plastic when wet; many unstained sand and silt sized grains.
- B_{21t} 2-7" Light yellowish brown (10yr5/4 when dry) clay loam; dark yellowish brown (10yr4/4 when moist); strong fine and medium prismatic structure separating to strong fine blocks; very hard when dry; very friable when moist sticky and plastic when wet.
- B_{22t} 7-9" Light yellowish brown (10yr5/4 when dry) heavy loam; dark yellowish brown (10yr4/4 when moist); strong medium prismatic structure separating to moderate medium blocks; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet.
- B_{3ca} 9-20" Light olive brown (2.5y5/4 when dry) loam; olive brown (2.5y4/4 when moist); strong medium prismatic structure; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence; few soft masses of segregated lime.
- C_{1ca} 20-36" Light brownish yellow (2.5y6/3 when dry) loam; light olive brown (2.5y5/3 when moist); massive; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence; few soft masses of segregated lime.

(Stoneham Series cont.)

- C₂ 36-46" Light brownish yellow (2.5y6/3 when dry) loam; light olive brown (2.5y5/3 when moist); massive; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.
- C₃ 46-66" Light olive brown (2.5y5/3 when dry) stratified loam and fine sandy loam with a few thin silt loam and very fine sandy loam strata; olive brown (2.5y4/3 when moist); slightly hard when dry; very friable when moist; strong effervescence.

STONEHAM SERIES

Classification: Ustollic Haplargid-fine-loamy, mixed, mesic

Location: Sec. 4 T9S R40E 1400 feet north and 600 feet east of S $\frac{1}{4}$ corner.

- A_p 0-4" Grayish brown (10yr5/2 when dry) loam; dark grayish brown (10yr4/2 when dry); moderate fine and medium granular structure; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet.
- B₁ 4-6" Grayish brown (10yr5/2 when dry) heavy loam; dark grayish brown (10yr4/2 when moist); moderate medium prismatic structure separating to moderate fine and medium blocks; hard when dry; very friable when moist; slightly sticky and plastic when wet.
- B_{2t} 6-10" Brown (10yr5/3 when dry) light clay loam; dark brown (10yr4/3 when moist); strong medium prismatic structure separating to strong fine and medium blocks; very hard when dry; friable when moist; sticky and plastic when wet.
- B₃₁ 10-14" Pale brown (10yr6/3 when dry) heavy loam; brown (10yr5/3 when moist); strong medium prismatic structure separating to moderate medium and coarse blocks; hard when dry; very friable when moist; slightly sticky and plastic when wet; moderate effervescence.
- B_{32ca} 14-24" Light brownish gray (10yr6/2 when dry) loam; grayish brown (10yr5/2 when moist); moderate medium prismatic structure separating to moderate fine and medium blocks; strong effervescence; common soft masses of segregated lime
- C_{1ca} 24-38" Light brownish gray (10yr6/2 when dry) loam; dark grayish brown (10yr4/2 when moist); weak coarse prismatic in upper and massive in lower part; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong

(Stoneham Series Clca cont.)

effervescence; few soft masses of segregated lime.

C₂ 38-60" Grayish brown (10yr5/2 when dry) loam and silt loam stratified; dark grayish brown (10yr4/2 when moist); hard when dry; very friable when moist; slightly sticky and plastic when wet; strong effervescence.

C₃ 60-66" Loam and fine sandy loam stratified.

TASSEL SERIES

This series consists of shallow soils formed in sandy loam residuum on the sedimentary bedrock uplands. Typically these soils have grayish brown sandy loam surface and light yellowish brown substratum underlain by weakly consolidated calcareous sandstone within 20 inches.

Typical profile of Tassel fine sandy loam in Section 21 T9S R40E near N $\frac{1}{4}$ corner:

- A₁ 0-2" Grayish brown (2.5y 5/2 when dry) fine sandy loam, dark grayish brown (2.5y 4/2 when moist); weak fine granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet.
- C₁ 2-4" Light olive brown (2.5y 5/4 when dry) heavy fine sandy loam; olive brown (2.5y 4/4 when moist); weak coarse blocky structure; hard when dry, very friable when moist, slightly sticky and nonplastic when wet.
- C₂ 4-12" Light yellowish brown (2.5y 6/3 when dry) heavy sandy loam; light olive brown (2.5y 5/3 when moist), weak coarse prismatic structure, slightly hard when dry; very friable when moist, slightly sticky and nonplastic when wet, very strong effervescence.
- C₃ 12-15" Sandy loam with a few fragments of soft sandstone, violent effervescence, this is the weathered beds.

C₄ 16-30" Strongly calcareous weakly consolidated sandstone.

Range in Characteristics: Depth to the weakly consolidated sandstone is 6 to 20 inches. The soil is either noncalcareous or calcareous throughout.

The Tassel soils occur in association with the Corkim, Nelson, Olney, Shingle, and Terry soils.

TENSLEEP SERIES

This series consists of deep, well drained soils formed in red colored silty alluvium on fans and terraces. Typically these soils have a reddish brown silt loam surface, reddish brown calcareous blocky silty clay loam subsoils and brown stratified loam substratum.

Typical Profile of Tensleep silt loam in Sec. 10 T9S R40E 1000 feet south and 200 feet east of NW corner.

A_p 0-5" Reddish brown (5yr5/3 when dry) silt loam; reddish brown (5yr4/3 when moist); moderate fine and very fine granular structure; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; very weak effervescence.

B₁ 5-8" Reddish brown (5yr5/4 when dry) heavy silt loam; reddish brown (5yr4/3 when moist); moderate medium prismatic structure separating to moderate fine subangular blocks; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; weak effervescence.

B_{21ca} 8-15" Reddish brown (5yr5/4 when dry) silty clay loam; reddish brown (5yr4/3 when moist); strong fine and medium prismatic structure separating easily to strong fine and medium blocks; very hard when dry; friable when moist; sticky and plastic when wet; moderate effervescence.

B_{22ca} 15-22" Brown (7.5yr5/4 when dry) silty clay loam; reddish brown (7.5yr4/3 when moist); strong medium prismatic structure separating to moderate medium and coarse blocks; very hard when dry; friable when moist; sticky and

plastic when wet; moderate effervescence with a few soft masses of lime.

B₃ca 22-32" Brown (7.5yr5/4 when dry) silty clay loam; reddish brown (5yr4/3 when moist); moderate medium prismatic structure separating to weak medium blocks; very hard when dry; friable when moist; slightly sticky and slightly plastic when wet; strong effervescence with a few threads of lime.

C₁ 32-44" Brown (7.5yr5/4 when dry) light clay loam; reddish brown (5yr4/3 when moist); massive; very hard when dry; friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.

C₂ 44-54" Brown (7.5yr5/4 when dry) heavy loam; reddish brown (5yr4/4 when moist); massive; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.

C₃ 44-66" Brown (10yr5/3 when dry) loam and fine sandy loam; dark yellowish brown (10yr4/4 when moist); stratified; soft when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence.

TERRY SERIES

This series consists of moderately deep, sandy loam soils on the sedimentary bedrock uplands. Typically these soils have brown sandy loam A horizon, brown prismatic sandy loam B₂ horizon, and sandy loam C horizons underlain by weakly consolidated calcareous sandstone at about 30 inches.

Typical Profile of Terry in Section 18 T9S R41E about 400 feet north and 200 feet east of W $\frac{1}{4}$ corner:

- A₁ 0-8" Grayish brown (10yR 5/2 when dry) light sandy loam; dark brown (10yR 3/3 when moist); single-grained; loose when dry and moist; nonsticky and nonplastic when wet.
- B₂ 8-20" Yellowish brown (10yR 5/4 when dry) sandy loam; dark yellowish brown (10yR 4/4 when moist); moderate coarse prismatic structure; slightly hard when dry; very friable when moist, nonsticky and nonplastic when wet.
- B₃ 20-26" Olive yellow (2.5y 6/5 when dry) sandy loam; light olive brown (2.5y 5/5 when moist); weak coarse prismatic structure; slightly hard when dry; very friable when moist; nonsticky and nonplastic when wet.
- C₁ca 26-40" Olive yellow, weakly consolidated sandstone bedrock.

TRAVESILLA SERIES

This series consists of shallow soils formed in materials weathered in place from consolidated sandstone. Typically these soils have channery loam or sandy loam surface and substratum layers underlain by hard sandstone within 20 inches.

Profile Description

None obtained because of limited extent of series in survey area.

The content of sandstone fragments varies considerably.

TULLOCK SERIES

This series consists of moderately deep soils formed in sandy residuum on sedimentary bedrock uplands. Typically these soils have a grayish brown loamy sand surface and loamy sand substratum underlain by weakly consolidated sandstone at about 32 inches.

Typical Profile of Tullock loamy sand in Section 18 T9S R41E about 600 feet north and 600 feet west of center of section:

- A₁ 0-6" Grayish brown (2.5y 5/2 when dry) loamy sand; dark grayish brown (2.5y 4/2 when moist), single-grained; loose when dry or moist.
- C₁ 6-24" Light yellowish brown (2.5y 5/6 when dry) loamy sand; olive brown (2.5y 4/4 when moist), massive; soft when dry, very friable when moist.
- C₂ 24-32" Olive yellow (2.5y 6/6 when dry) loamy sand; olive brown (2.5y 4/6 when moist); massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; moderate effervescence.
- C₃ 32-50" Weakly consolidated calcareous sandstone. This material is compact and somewhat resistant to auger and to root penetration, but is easily crushed with fingers when wet.

Range in Characteristics: The texture of the control section (10 inches down to bedrock) is loamy fine sand, loamy sand, or fine sand. Part or all of the regolith above the bedrock may or may not be

calcareous. Typically the colors are in 2.5y and 10yR hues, but where associated with the red soils they have hues of 7.5yR and redder.

VALENT SERIES

This series consists of deep soils formed in sandy materials on sedimentary uplands. Typically these soils have a loamy sand surface and substratum.

Typical profile of Valent loamy sand in Section 18 T9S R41E in SW $\frac{1}{4}$:

- A₁ 0-8" Grayish brown (10yR 5/2 when dry) loamy sand;
 dark brown (10yR 3/3 when moist); single-grain; loose;
 nonsticky and nonplastic.
- A_c 8-18" Grayish brown (10yR 5/2 when dry) loamy sand;
 dark brown (10yR 4/3 when moist); single-grain; loose;
 nonsticky and nonplastic.
- C₁ 18-30" Yellowish brown (10yR 5/6 when dry) loamy sand;
 dark yellowish brown (10yR 4/6 when moist); soft, very
 friable, nonsticky and nonplastic.
- C₂ 30-60" Light olive brown (2.5y 5/4 when dry) light loamy
 sand, or sand; olive brown (2.5y 4/4 when moist), soft,
 very friable, nonsticky and nonplastic; some resistance to
 auger. Probably strongly weathered weakly consolidated
 sandstone.

Range in Characteristics: The texture of 10 to 40 inch control section is loamy fine sand, loamy sand, or fine sand. Typically the entire profile is noncalcareous but lime is present below 36 inches in some profiles.

Where these soils occur in areas of Sperlin or Wibaux, they have hues of 7.5yR and redder in upper part or throughout.

Weakly consolidated sandstone or loamstone will underlay these soils at depths between 40 and 60 inches in places.

WANETTA SERIES

This series consists of deep well-drained soils formed in loamy alluvium on terraces. Typically these soils have grayish brown loam surface, brown prismatic clay loam subsoils underlain by loose sands and gravels between 20 and 40 inches.

Typical Profile of Wanetta loam in Sec. 1 T9S R40E about 800 feet south and 1200 feet east of NW corner.

- A_p 0-6" Grayish brown (10yr5/2 when dry) loam; dark grayish brown (10yr4/2 when moist); weak fine granular structure; slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet.
- B₁ 6-8" Brown (10yr5/3 when dry) heavy loam; dark brown (10yr 4/3 when moist); strong medium prismatic structure separating to moderate coarse plates; hard when dry; friable when moist; slightly sticky and slightly plastic when wet.
- B_{2t} 8-20" Yellowish brown (10yr5/4 when dry) clay loam; dark yellowish brown (10yr4/4 when moist); strong medium prismatic separating to moderate medium blocks; very hard when dry; friable when moist; sticky and plastic when wet; few fine sandstone and scoria fragments.
- B₃ 20-28" Yellowish brown (10yr5/4 when dry) loam; dark yellowish brown (10yr4/4 fwhen moist); moderate medium prismatic structure; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; about 10 to 15 percent fine angular sandstone and scoria fragments; weak effervescence in lower part; becomes coarse sandy loam in lower part.

(Wanetta Series cont.)

IIC 28-48" Loose coarse and very coarse sands with about 30 percent by volume of fine gravels; weak effervescence in upper part but increasing with depth.

Range in Characteristics: Depth to sand and gravel is 20 to 40 inches. The B₂t is sandy clay loam or clay loam with 22 to 35 percent clay. Segregated lime is present above the coarse substratum in most profiles. Colors are in 2.5y or 10yr hues.

WIBAUX SERIES

This series consists of shallow soils formed in red colored residuum on the sedimentary bedrock uplands. Typically these soils have reddish brown loam surface and substratum underlain by hard sandstone or porcylanite within 20 inches.

Typical Profile of Wibaux gravelly loam in Sec. 1 T9S R40E.

- A₁ 0-4" Reddish brown (5yr5/3 when dry) angular gravelly light loam; dark reddish brown (5yr3/3 when moist); weak fine granular; soft when dry; very friable when moist; nonsticky and nonplastic when wet; weak effervescence; 25 percent small channers
- C₁ 4-12" Light reddish brown (5yr6/3 when dry) angular gravelly light loam; reddish brown (5yr4/3 when moist); massive; soft when dry; very friable when moist; nonsticky and nonplastic when wet; strong effervescence; 20 percent by volume angular fragments of sandstone and scoria.
- R 12"+ Hard sandstone.

Range in Characteristics: Depth to bedrock is 4 to 20 inches. Texture of regolith is loam or sandy loam with less than 15 percent clay and 10 to 35 percent by volume of coarse fragments.

WIBAUX SERIES

Classification: Lithic Ustic Torriorthents loamy, mixed (calcareous) mesic family.

Location: Sec. 10 T9S R40E, about 1200 feet south of N $\frac{1}{4}$ corner on north east facing 20 percent slope.

Profile Description: Wibaux fine sandy loam.

A₁ 0-3" Reddish brown (5yr4/3 when dry) fine sandy loam; dark reddish brown (5yr3/3 when moist); single-grained; loose when dry and moist; nonsticky and nonplastic when wet; 5 percent angular sandstone fragments weak effervescence.

C₁ 3-14" Reddish brown (5yr5/3 when dry) fine sandy loam; reddish brown (5yr4/3 when moist); massive; loose when dry and moist; nonsticky and nonplastic when wet; 5 percent flat sandstone fragments; strong effervescence.

CR 14-20" Weathered sandstone; platy about 70 percent flat sandstone fragments which are strongly weathered

R 20"+ Consolidated sandstone.

YENLO SERIES

This series consists of deep well-drained soils formed in loamy alluvium on fans and terraces. Typically these soils have a light brownish gray fine sandy loam surface, brown clay loam subsoils that are columnar in upper few inches and blocky prismatic below and loam substratum with segregated lime and gypsum.

Typical Profile of Yenlo fine sandy loam in Sec. 16 about 750 feet east and 100 feet south of NW corner.

A₁₁ 0-1" Light brownish gray (10yr6/2 when dry) light fine sandy loam; dark grayish brown (10yr4/2 when moist); vesicular massive crust; soft when dry; very friable when moist; nonsticky and nonplastic when wet; many unstained sand and silt sized grains.

A₁₂ 1-5" Grayish brown (10yr5/2 when dry) light fine sandy loam; dark grayish brown (10yr4/2 when moist); strong fine and medium platy structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet.

B_{21t} 5-8" Brown (10yr5/3 with 4/2 coats when dry) heavy clay loam; dark brown (10yr4/3 with 3/2 coats when moist); strong medium columnar structure separating to moderate fine and medium blocks; extremely hard when dry; firm when moist; sticky and plastic when wet.

B_{22t} 8-14" Brown (10yr5/3 when dry) clay loam; dark brown (10yr4/3 when moist); strong medium and coarse prismatic structure separating to segments; extremely hard when dry; firm when moist; sticky and plastic when wet.

(Yenlo Series cont.)

B₃ca 14-24" Light yellowish brown (2.5y6/3 when dry) heavy loam or light clay loam; light olive brown (2.5y5/3 when moist); moderate medium prismatic structure separating to moderate fine and medium subangular blocks; very hard when dry; friable when moist; slightly sticky and slightly plastic when wet; strong effervescence with a few soft masses and threads of segregated lime.

C₁ca 24-40" Light yellowish brown (2.5y6/3 when dry) heavy loam; light olive brown (2.5y5/3 when moist); massive; very hard when dry; friable when moist; slightly sticky and slightly plastic when wet; strong effervescence with a few soft masses and threads of segregated lime.

C₂ 40-66" Light yellowish brown (2.5y6/3 when dry) loam with thin strata of fine sandy loam; light olive brown (2.5y5/3 when moist); hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; strong effervescence.

Range in Characteristics: The A horizon is 4 to 7 inches thick. A very thin A₂ horizon is present in some places. The texture of B₂t averages a clay loam or sandy clay loam with 30 to 35 percent clay. The columnar structure is absent in many profiles. The lower few inches of B₂t has weak effervescence in places. The B₃ca and upper C horizon are loam, light sandy clay loam or light clay loam with 24 to 30 percent clay. Sandy loam can occur at any depth below 50 inches.

YENLO SERIES BEDROCK SUBSTRATUM

This series is a member of a fine loamy, mixed, mesic family of Ustollic Natrargids. Typically these soils have light brownish gray fine sandy loam A horizons; clay loam B_{2t} horizons that are columnar in upper part and blocky prismatic in lower part, blocky prismatic clay loam B_{3ca} horizons with segregated lime; clay loam B_{3c} and Cca horizons with segregated lime and gypsum underlain by weakly consolidated loamstone at about 3 feet.

Typical Pedon: Yenlo fine sandy loam, bedrock substratum in Sec. 21 T9S R40E near N $\frac{1}{4}$ corner.

- A₁₁ 0-3" Grayish brown (10yr5/2 when dry) fine sandy loam; dark grayish brown (10yr4/2 when moist); vesicular massive in upper 1 inch; weak fine granular in lower part; soft when dry; very friable when moist; nonsticky and nonplastic when wet.
- A₁₂ 3-7" Brown (10yr5/3 when dry) fine sandy loam; dark brown (10yr4/3 when moist); weak medium prismatic separating to weak fine subangular blocks; soft when dry; very friable when moist; nonsticky and nonplastic when wet.
- B_{21t} 7-9" Yellowish brown (10yr5/4 when dry) light sandy clay; dark brown (10yr4/3 when moist); strong fine and medium columnar structure; extremely hard when dry; friable when moist; sticky and plastic when wet.
- B_{22t} 9-12" Yellowish brown (10yr5/4 when dry) heavy sandy clay loam; dark yellowish brown (10yr4/4 when moist); strong medium prismatic structure separating to moderate medium blocks; extremely hard when dry; friable when moist; sticky and plastic when wet.

(Yenlo Series cont.)

B₂₃tca 12-14" Yellowish brown (10yr5/4 when dry) clay loam; dark yellowish brown (10yr4/4 when moist); strong medium prismatic separating to strong medium blocks; extremely hard when dry; friable when moist; sticky and plastic when wet weak effervescence with a few soft masses of segregated lime.

B₃ca 14-26" Light yellowish brown (2.5y6/3 when dry) silty clay loam; light olive brown (2.5y5/3 when moist); strong fine and medium prismatic structure separating to strong medium blocks; extremely hard when dry; friable when moist; sticky and plastic when wet; strong effervescence with common soft masses of segregated lime.

C₁cacş 26-36" Light yellowish brown(2.5y6/3 when dry) silty clay loam; light olive brown (2.5y5/3 when moist); massive; extremely hard when dry; friable when moist; sticky and plastic when wet; strong effervescence with a few soft masses of lime and few to common seams and nests of gypsum.

C₂ 36-50" Weakly consolidated loamstone which is weathered in upper few inches.

Range in Characteristics: The B₂ horizon is a sandy clay loam or clay loam with 32 to 39 percent clay. Depth to bedrock is 30 to 44 inches.

Soil phases mapped in the Decker area

Alluvial lands, loamy (Unit 2)

This unit is on the flood plains and bottomlands in the valleys of the smaller tributary streams, ranging from less than 100 to about 200 feet in width. It consists of several soils of varying textures and varying depth to sand or gravel. The principal soils have characteristics similar to those in the Haverson series. The other most important soil is a deep, sandy loam soil.

The soils in this unit have been dissected to varying degrees by stream channels. They may or may not be subject to overflow and deposition of fresh materials during periods of high runoff.

The steep sidewalls flanking the stream valley are included with this unit in places.

Alluvial lands, loamy, saline (Unit 32)

This unit occurs in the bottom of and adjacent to the small tributary streams. The soils have textures and other properties similar to those in mapping unit 2, Alluvial lands, loamy.

They are wet or somewhat wet during all or part of each year and contain varying concentrations of soluble salts.

Colbar silt loam (Unit 11A)

This unit is on nearly level fans and terraces with slopes of less than 2 percent. It consists mainly of Colbar silt loam but includes Colbar silty clay loam also. These two phases combined make up more than 90 percent of the composition of mapping unit. The other 10 percent consists of Corkim loam, Kim loam, McRae loam, Noude silt loam or Redby silt loam, one or more of which can occur within any given delineation.

Colbar silt loam (Unit 11C)

This unit is on the sloping fans and footslopes immediately below the steep sedimentary bedrock upland. Slopes are dominantly between 2 and 6 percent but slopes as steep as 8 or 10 percent will occur in places. It consists of both Colbar silt loam but includes areas of Colbar silty clay loam up to 10 acres in size. These two phases make up more than 80 percent of the composition. The other 20 percent includes Kim loam, McRae loam, Nevee silt loam, or Redby silt loam, all or any one of which can occur as small inclusions in areas less than 3 acres in size in any given delineation.

The Colbar soils are dominantly more than 5 feet deep but in this mapping bedrock can occur at any depth below 48 inches.

Corkim loam (Unit 4)

This unit is on nearly level terraces with slopes of less than 2 percent and on gently sloping fans with slopes of 2 to 4 percent. Corkim loam makes up more than 90 percent of the composition. The other 10 percent consists of Colbar silt loam, Haverson loam, Kim loam, Nelar loam, or a deep, sandy loam soil. Any one or more of these can occur in any delineation in areas less than 2 acres in size.

Corkim loam (Unit 4C)

This unit is on the sloping fans and footslopes immediately below the steep sedimentary bedrock uplands. Slopes range between 4 and 10 percent. Corkim loam makes up more than 90 percent of the composition. McRae loam, Nelson or Tassel fine sandy loams, and a deep, sandy loam soil can occur as small inclusions. The Corkim soils are dominantly more than 5 feet deep, but this unit bedrock can occur at any depth below 40 inches in places.

This is the phase of Corkim loam that occurs in mapping unit 28 (Tassel-Corkim loams).

Haverson loam (Unit 12)

This mapping unit is on the level bottomlands and flood plains along the Tongue River and in the wider valleys of the tributary streams. It consists mainly of Haverson loam but includes Haverson clay loam also. These two phases of Haverson make up more than 85 percent of composition. The remaining 15 percent consists of a deep, sandy loam soil and small inclusions of Corkim loam and/or McRae loam in places.

Where mapped in the valley of Deer Creek east of the Tongue River, these soils are more highly stratified and the average of the 10 to 40 inch control section has less than 18 percent clay. Also, the deep sandy loam soil makes up a higher percentage of the composition.

Heldon silty clay (Unit 34)

This mapping unit is on the level terrace in sec. 3 and 10, T. 9 S., R. 40 E. Slopes are less than 1 percent. Heldon silty clay makes up more than 95 percent of this unit.

Keiser silty clay loam (Unit 7)

This mapping unit is on the level and nearly level terraces and fans with slopes of less than 2 percent. Keiser silty clay loam makes up more than 75 percent of composition. Hesper silty clay loam will make up about 10 to 15 percent of composition in all delineations. Other soils which can occur as inclusions are Stoneham loam and clay loam in areas up to 5 acres in size and Okar silty clay loam in areas of less than 1 acre in size.

Keiser-Okar silty clay loam (Unit 31)

This mapping unit is a complex consisting mainly of Keiser silty clay loam and Okar clay loam and silty clay loam; but with inclusions of other soils. It is on nearly level fans and terraces with slopes of less than 2 percent.

Keiser soils make up about 35 to 45 percent. Okar soils about 30 to 40 percent and other soils about 15 to 25 percent of the composition of this unit.

The barren or nearly barren depressions, which are within the range of the Okar series, comprise about 10 to 15 percent of composition areawise, but will make up as much as 30 to 40 percent of composition in areas less than 2 acres in size and less than 10 percent in areas less than 1 acre in size.

A soil with surface layers more than 4 inches thick and columnar clayey subsoils is the most important of the included soils in this unit. Minor soils which can occur are Anko clay loam, Olney fine sandy loam, Stoneham loam, and Yenlo fine sandy loam.

The Keiser soils are likely to have a higher SAR at some depth about 5 feet in this mapping unit than in mapping unit 7.

Kim loam (Unit 6)

This unit is on the sloping fans and footslopes immediately below and flanking the steep uplands of shale outcrop and Midway-Shingle Shale outcrop. Slopes range from 2 to 8 percent.

Kim loam comprises about 70 percent of the unit. Small spots of Hysham loam and clay loam less than 1 acre in size make up about 5 percent of this unit areawise but can make up as much as 10 to 15

percent of composition in local areas up to 5 acres in size. Other soils which commonly occur are Colbar silt loam, Corkim loam, and McRae loam in areas up to 3 acres in size.

Kim soils are typically more than 6 feet deep, but in this mapping unit bedrock can underlay these soils at any depth below 40 inches in places.

McRae loam (Unit 21)

This unit is on a gently sloping fan with slopes between 2 and 4 percent. McRae loam makes up more than 90 percent of the composition. Small areas of Kim loam and Olney fine sandy loam are included.

Nelar loam (Unit 3)

This unit is on fans and footslopes and in swales and drainageways adjacent to and associated with the burned shale uplands. Slopes are mainly between 2 and 6 percent but include some slopes up to 10 percent.

On some of the footslopes areas of Sperlin or Wibaux soils less than 1 acre in size are included within the mapping unit. In these positions, bedrock can underlay these soils between 40 and 60 inches.

On some fans and footslopes, the coarse fragments will exceed 35 percent in some part of the 5 foot profile in areas less than 3 acres in size.

In sections 7 and 18 east of the Tongue River, this mapping unit includes soils that are sandy loam throughout. In section 1, small areas of Nevee silt loam are included.

Nelson-Tassel fine sandy loams (Unit 26)

This unit is on the rolling sedimentary bedrock uplands. Slopes are dominantly between 6 and 15 percent. Slopes steeper than 16 percent

along drainageways are included. It is made up of 60 to 70 percent Nelson fine sandy loam, 20 to 35 percent Tassel fine sandy loam, and 5 to 10 percent Corkim loam, Olney fine sandy loam Alice fine sandy loam, or Glenberg fine sandy loam.

The shallow Tassel soils are on the convex ridges and crests. The Nelson soils are on the mid and lower slopes below these crests. The deeper soils are on the small fans, footslopes, in swales and drainageways in areas up to 2 acres in size.

The Tassel soils range in depth between 10 and 20 inches and Nelson soils 20 to 32 inches to weakly consolidated sandstone. In places, more consolidated sandstone will underlay either or both of these soils.

Included are areas of Midway, Shingle, or Tullock soils less than 1 acre in size.

Nelson-Tassel rocky sandy loams (Unit 33)

This unit is on the rolling sedimentary bedrock uplands with slopes dominantly between 6 and 15 percent. The distinctive feature of this unit are the outcroppings of sandstone and clinker. It consists of about 50 to 60 percent Nelson rocky sandy loam, 30 to 40 percent Tassel rocky sandy loam and a deep sandy loam in swales and drainageways.

Both the Nelson and Tassel soils have red colors where this unit merges or abuts against unit 25- Sperline- Wibaux rocky loams.

Nevee silt loam (Unit 16)

This unit is on gently sloping fans below the burned siltstone uplands. Slopes are between 2 and 4 percent. Nevee silt loam makes up more than 90 percent of composition. Small areas of Colbar silt loam,

Nelar loam, Neville loam, and Redby silt loam less than 2 acres in size are included.

On the upper part of the fans near their juncture with the uplands, this soil will contain up to 15 percent flat angular scoria fragments. Typically these soils are more than 60 inches deep, but in places will be underlain by bedrock between 40 and 60 inches.

Neville loam (Unit 10)

This unit is on nearly level terraces with slopes of less than 2 percent and on a gently sloping upland fan with slopes between 2 and 4 percent. Neville loam comprises more than 90 percent of the composition of this unit. Colbar silt loam, Nelar loam and Redby silt loam are the main inclusions.

On the upland fan in sec. 18, T. 9 S., R. 41 E., bedrock will underlay this soil within 2 feet or less in places.

Olney fine sandy loam (unit 30)

This unit is on nearly level and gently sloping fans with slopes between 1 and 4 percent.

Olney fine sandy loam makes up more than 85 percent of this mapping unit. In some delineations, Yenlo fine sandy loam will make up about 10 percent of composition. Small spots of Anko soils are also present in places, making up less than 1 percent of composition.

The depth to bedrock is typically more than 5 feet but can be underlain by bedrock between 40 and 60 inches on some slopes.

Redby silt loam (Unit 14)

This unit is on nearly level fans and terraces with slopes of less than 2 percent. Redby silt loam comprises more than 85 percent of the

composition. The remaining 15 percent consists of Colbar silt loam, Nelar loam, Nevee silt loam and Neville loam in areas of less than 5 acres in size.

The surface 6 to 10 inches is silty clay loam rather than silt loam.

Shale outcrop (Unit 20)

This mapping unit is on very steep, rough broken, and dissected topography. It consists of areas having more than 80 percent barren claystone and/or siltstone. The other 20 percent is made up of Midway, Shingle, or Tassel soils which are less than 6 inches deep over the bedrock and support very sparse cover or vegetation.

Shingle-Midway complex (Unit 17)

This mapping unit is a complex of Shingle loam and silt loam and Midway silty clay loam on the rolling siltstone and shale bedrock upland. Slopes are mainly between 5 and 20 percent. Steeper slopes along streamways are included.

Midway silty clay loam and Shingle loam and silt loam together make up more than 80 percent of the composition. Areas of Tassel sandy loam on the crests of ridges in some areas are included. Loam, silt loam and silty clay loam soils 20 to 40 inches deep to bedrock are present in all delineations and can make up as much as 20 percent of the unit in places. Colbar, Kim, or McRae soils can occur in swales and drainageways, and on small fans in areas of less than 2 acres in size.

Both the Midway and Shingle soils are 10 to 20 inches deep to bedrock.

Shingle-Midway complex (Unit 17E)

This mapping unit is a complex of Shingle soils and Midway soils on hilly and steep siltstone and shale bedrock uplands. Slopes are dominantly between 20 and 45 percent but steeper slopes are included in places.

Midway and Shingle soils make up about 70 percent of this unit in most delineations. Shale and rock outcrop make up about 5 percent in areas less than 1 acre in size. Other soils which occur in most of these delineations are Tassel sandy loam which make up as much as 10 percent of composition in places. Colbar, Kim, or McRae soils on small fans and footslopes of less than 2 acres in size are included.

In this unit, Midway and Shingle soils are 4 to 14 inches deep over bedrock.

Shingle-Midway-shale outcrop complex (Unit 27)

This mapping unit is a complex of Shingle loam and silt loam, Midway silty clay loam with outcrops of shale and siltstone. It is on steep and very steep sedimentary uplands with slopes generally steeper than 80 percent and shale and rock outcrops 20 to 40 percent of composition. Ledges of sandstone or outcrops of clinker will occur in places in this unit.

In this unit, both the Shingle and Midway soils are dominantly less than 8 inches deep to bedrock.

Shingle-Travessilla complex (Unit 19)

This mapping unit is a complex of Shingle loam and silt loam and Travessilla loam and sandy loam and Channery loam and sandy loam. It is on the rolling siltstone and sandstone sedimentary bedrock uplands

with slopes dominantly between 4 and 10 percent. Shingle and Travessilla soils combined make up about 85 to 90 percent of composition, being of about equal proportions. The other 10 to 15 percent consists of Nelson, Tassel and other soils in small areas.

Shingle-Travessilla complex (Unit 19E)

This mapping unit is a complex of Shingle soils and Travessilla soils hilly and steep siltstone and sandstone sedimentary bedrock uplands with slopes of 20 to 45 percent. It consists of Shingle loam and silt loam, Midway clay loam and Travessilla loam, sandy loam and Channery loams. The Shingle and Midway soils combined make up about 55 to 65 percent Travessilla soils about 20 to 30 percent, and siltstone and sandstone outcrops 5 to 10 percent, and other soils such as Midway, Tassel or Wibaux up to 20 percent of composition.

Shingle-Wibaux complex (Unit 9)

This mapping unit is a complex of Shingle loam, silt loam and gravelly loam and Wibaux gravelly and Channery loam on the rolling to hilly shale uplands. Slopes are dominantly from 20 to 45 percent with some small inclusions of areas having slopes of less than 20 percent and greater than 45 percent.

Shingle loam and silt loam make up about 50 to 70 percent Wibaux, Channery and gravelly loam, 20 to 35 percent, shale and/or rock outcrop about 5 percent, and deep soils in valleys less than 5 percent of composition. The Shingle soils are on the lower slopes below the Wibaux soils which are mainly on the tops of ridges and crests.

In this unit, the upper part of the Shingle soils has reddish colors.

Shingle-Wibaux-shale outcrop complex (Unit 29)

This mapping unit is a complex of Shingle loam, silt loam and gravelly loam, Wibaux gravelly, Channery and stony loams and outcropping of sandstone clinker, and/or siltstone. It is on hilly and steep burned shale uplands with slopes dominantly more than 40 percent.

The Shingle soils make up about 40 to 50 percent, Wibaux soils about 20 to 30 percent, Midway soils 10 to 20 percent and shale and/or rock outcrop about 15 to 25 percent. The outcroppings consist of siltstone, sandstone, or clinker.

In this unit, the Shingle and Midway soils are less than 10 inches deep to bedrock and the Wibaux soils are less than 6 inches deep.

Sperline-Wibaux loams (Unit 5)

This unit is on the rolling burned shale uplands. Slopes range between 5 and 15 percent.

This unit is made up of Sperline loam and gravelly loam and Wibaux gravelly and Channery loam. These two soils make up about 90 percent of the composition of which 40 to 60 percent is Sperline soils and 30 to 50 percent is Wibaux soils. The other 10 percent consists of Nelar loam in swales and rock outcrop. The Wibaux soils are on the convex ridges, crests and knolls. The Sperlin soils are on the mid and lower parts of the slopes below the Wibaux soils; on the longer and smoother slopes and on the broader crests and saddles. The Nelar soils are in the narrow drainageways, swales and other areas of accumulation less than 2 acres in size.

The Wibaux soils range in depth from less than 6 inches on the narrower ridges and crests to 20 inches near its boundary with the Sperlin soils which are 20 to 40 inches deep to bedrock.

In Sections 7, 8, and 18 east of the Tongue River the Sperlin and Wibaux soils are both dominantly sandy loam throughout their depth.

Sperline-Wabaux rocky loams (Unit 25)

This unit is on the rolling and hilly burned shale uplands. Slopes are dominantly between 10 and 25 percent but slopes as steep as 40 percent are included in some areas.

The distinguishing feature of this unit is the presence of outcroppings of fused sandstones or "clinker". These make up about 1 to 5 percent of the composition areawide but make up as much as 10 to 20 percent of composition in areas of less than 10 acres in size.

Sperline loam and Wibaux rocky loam combined comprise more than 90 percent of the composition. Nelar loam on small fans and footslopes and in narrow swales and drainageways make up about 5 percent in areas of $\frac{1}{2}$ to 2 acres in size.

Wibaux rocky soils are on the crests and ridges and make up about 30 to 50 percent of composition. Sperline soils are on the mid and lower parts of the slopes below the Wibaux soils and on the broader and smoother divide. They make up about 40 to 60 percent of composition.

In Sections 7, 8, and 18, T. 9 S., R. 41 E., these soils are primarily sandy loam.

Stoneham loam (Unit 24)

This unit is on level and nearly level fans and terraces with slopes of less than 2 percent.

Stoneham loam makes up more than 90 percent of the composition of this unit. The remaining 10 percent can be any one or all of the

following soils with noncalcareous solum more than 10 inches thick;

Keiser silty clay loam, Olney fine sandy loam, or Yenlo fine sandy loam.

Tassel-Corkim loams (Unit 28)

This unit consists mainly of Tassel fine sandy loam and Corkim loam on rolling and sloping areas below the steeper sedimentary uplands. Slopes are dominantly 6 to 15 percent on the Tassel soils and 4 to 10 percent on the Corkim and other soils.

The Tassel soils are on the convex ridges between the drainageways and make up about 40-50 percent of the composition in areas up to 5 acres in size. The Corkim soils are on the small fans and in the swales and drainageways between and surrounding the areas of Tassel soils. They make up about 30 to 40 percent of composition. Other soils which occur are Nelson fine sandy loam on the slopes below the crests of Tassel soils, Olney fine sandy loam in some of swales, and Shingle soils on lower parts of slopes along the deeper streamways.

Tassel-Shingle loams (Unit 18)

This unit consists of Tassel sandy loam and Shingle loam and silt loams on strongly rolling sedimentary bedrock uplands. Slopes are dominantly 10 to 20 percent. Tassel soils and Shingle soils together comprise more than 85 percent of the composition of this unit. The other 15 percent is made up of inclusions of Corkim loam, Olney fine sandy loam, and a deep sandy loam soil on fans and footslopes in areas less than 2 acres in size; Travessilla soils or Nelson sandy loam.

Tassel soils are generally on the crests and upper parts of slopes and make up about 40 to 60 percent of composition. Shingle soils are on

the slopes below the Tassel soils and make up about 30 to 50 percent of the composition. An occasional sandstone outcrop or a barren exposure of siltstone can occur. In some areas rounded gravels are scattered on the surface.

Tassel-Shingle loams (Unit 18E)

This unit is on the hilly sedimentary bedrock uplands. Slopes are dominantly between 20 and 45 percent but slopes steeper than 45 percent can occur.

Tassel sandy loam and Shingle loam and silt loam combined comprise about 80 percent of the composition with the Tassel soil and Shingle soils about equally divided. Shale and/or rock outcrops can make up as much as 5 percent of composition.

The remainder consists of deep soils such as Corkim loam, McRae loam, Olney fine sandy loam and/or a deep sandy loam on small fans, on footslopes and in swales in areas of less than $\frac{1}{2}$ acre up to 2 acres in size. Nelson, Terry or Valent soils will also occur in most areas.

Tensleep silt loam (Unit 1)

This unit is on a nearly level terrace in secs. 3, 9, and 10, T. 9 S., R. 40 E. Slope is less than 2 percent. Tensleep silt loam makes up more than 90 percent of the composition of this mapping unit. The other 10 percent consists of Nelar loam, Nevee silt loam, and Redby silt loam in areas of less than 5 acres in size.

Terrace escarpments, loamy (Unit 40)

This mapping unit is on the steep and very steep sidewalls along the stream valleys. Slopes are greater than 30 percent. In places barren vertical banks of exposed alluvium are included. The textures

and other properties vary widely, but are generally similar to those of the soils on more level areas with which they are associated. They are generally more than 10 feet deep but in places, bedrock will outcrop along the deeper exposures, usually below depths of 8 feet.

Terry-Tassel sandy loams (Unit 38)

This unit is on the rolling sedimentary bedrock uplands. Slopes are dominantly between 6 and 16 percent. Slopes steeper than 16 percent along drainageways are included.

The Terry and Tassel soils combined make up more than 85 percent of the composition of this unit. Other soils which occur are Valent and Tullock loamy sands in areas up to 10 acres in size, and a deep sandy loamy soil in swales and narrow drainageways and on small fans and footslopes in areas less than 2 acres in size.

The shallow Tassel soils are on the convex crests, knolls, and ridges. They make up about 20 to 30 percent of composition. The Terry soils are on the slopes below these crests and ridges and make up 50 to 60 percent of composition.

In this unit the Tassel soils are 12 to 20 inches deep and the Terry soils 24 to 48 inches deep over weakly consolidated sandstone. Consolidated sandstone can occur in places under the Tassel soils.

Valent-Tullock loamy sands (Unit 22)

This unit is on the rolling sedimentary uplands with slopes dominantly between 6 and 16 percent. These two soils combined made up about 80 percent of the composition. The Valent soils account for about 50 to 60

percent and Tullock soils about 20 to 30 percent. Other soils which occur as inclusions and make up the other 20 percent are Nelson and/or Terry fine sandy loam and Tassel sandy loam. The Valent soils are on the mid and lower parts of the slopes and in the concave areas. The Tullock soils are on the upper parts of long slopes and on the shorter and more convex slopes, and on the broader ridges and crests.

Wanetta loam (Unit 23)

This unit is on the remnants of high gravel-capped benches. The slopes are dominantly less than 2 percent. Wanetta loam makes up about 80 percent of the composition. The other 20 percent consists of soils that are less than 20 inches deep to the loose sand and gravel substratum and soils that are deeper than 40 inches to these materials.

In secs. 15 and 22, T. 9 S., R. 40 E., this unit occurs as small remnants, most of which are less than 5 acres in size. The largest area of this unit is in sec. 1, T. 9 S., R. 40 E. These soils are underlain by bedrock at depths of less than 8 feet in most cases.

Wibaux-Sperlin gravelly loams (Unit 8)

This unit is on the rolling burned shale and sandstone sedimentary uplands. Slopes are dominantly between 6 and 16 percent but slopes as steep as 25 percent occur along some of the drainage courses.

Wibaux gravelly loam, Channery loam, Sperlin loam, and gravelly loam combined comprise about 90 percent of this unit and Nelar loam and rock outcrop the remaining 10 percent. Wibaux soils are on the convex ridges and crests, on the knolls, and on the walls of drainageways. They make up 45 to 60 percent of the composition. Sperlin soils are on

the slopes below the Wibaux soils, on the broader and smoother crests and ridges, on concave slopes between the ridges, and in the heads of the shallower drainageways. They make up about 30 to 45 percent of the unit. Nelar soils which are in on small fans and footslopes, in the bottom of the larger drainageways, and in other areas of accumulation less than 2 acres in size, make up about 5 to 10 percent of unit. Outcrops of clinker and fused sandstone are scattered throughout this mapping unit.

The Wibaux soils range from about 4 inches to 20 inches and Sperlin soils 20 to 40 inches deep over bedrock. The Nelar soils are dominantly more than 5 feet deep, but can be underlain by bedrock between 40 and 60 inches in places.

Yenlo-Anko complex (Unit 13)

This mapping unit is a complex of Yenlo fine sandy loam and loam and Anko clay loam and sandy clay loam. It is on the nearly level fans and terraces with slopes of less than 2 percent. It is comprised of several soils. Yenlo fine sandy loam makes up about 50 to 60 percent Anko clay loam and sandy clay loam about 20 to 30 percent, Olney fine sandy loam and/or Stoneham loam about 10 to 15 percent and other soils 5 to 10 percent. The Anko soils occur in and adjacent to the barren or nearly barren depressions. Areawise these nearly barren spots make up about 5 to 10 percent of the composition of this unit, but in places, they will make up as much as 25 to 35 percent of the composition in areas of less than 2 acres in size.

Yenlo-Anko complex, bedrock substratum (Unit 15)

This mapping unit is a complex of Yenlo fine sandy loam and loam and Anko clay loam and sandy clay loam.

It is in concave swales and nearly level areas on the sedimentary bedrock uplands. Slopes are dominantly less than 4 percent.

It consists of 60 to 70 percent Yenlo fine sandy loam and 30 to 40 percent Anko clay loam and sandy clay loam. The barren or nearly barren depressions, which are part of Anko soils, make up about 5 to 15 percent areawise, but will comprise 30 to 40 percent of the composition of this unit area less than 1 acre in size.

This unit differs from unit 13 only in being underlain by weakly consolidated siltstone or sandstone at depths between 30 and 48 inches.

APPENDIX C

CLIMATE AND AIR QUALITY

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Table C-1.--Precipitation data, Decker, Montana (data from records of the National Weather Service)

[E indicates estimated; T indicates trace]

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Annual |
|------------------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|---------|
| 1949 | | | | | | | .56 | .16 | 1.10 | 1.56 | .92 | .19 | |
| 1950 | .32 | .30 | .66 | .87 | 1.17 | 2.50 | 2.05 | 2.12 | 1.45 | .25 | .55 | .36 | 12.60 |
| 1951 | .35 | .23 | .70 | 1.22 | 1.62 | 2.82 | 1.46 | 1.72 | 1.87 | 1.21 | .30 | .69 | 14.19 |
| 1952 | .08 | .49 | .60 | .20 | 1.99 | 2.70 | 2.38 | .48 | .06 | .34 | .10 | .30 | 9.72 |
| 1953 | .78 | .48 | .40 | 1.00 | 2.62 | 1.38 | 0 | 1.37 | .58 | .68 | .25 | .15 | 9.69 |
| 1954 | .24 | .29 | .96 | .59 | .94 | .64 | 1.61 | .85 | .99 | .68 | .15 | .09 | 8.03 |
| 1955 | .17 | .51 | .52 | .64 | 2.40 | 1.72 | .61E | .34E | .65 | .80E | .89E | 1.03E | 10.28E |
| 1956 | .30E | .37 | .77E | .69 | 2.95 | .57 | .84 | .76 | .37 | .77E | .60E | .10 | 9.09E |
| 1957 | .38 | .38 | .34 | 1.51 | 1.79 | 2.39 | 0 | 1.74 | .50 | 1.17 | .71 | .22 | 11.13 |
| 1958 | .14 | .62 | .35 | 2.58 | .54 | 3.18 | 3.46 | .33 | .10 | ----- | 1.63E | .54 | |
| 1959 | .29 | | | | | 1.45 | 0 | .10 | | | | | |
| 1960 | .10E | .41E | .26E | .52 | .43 | .92 | .18 | 1.61 | .20 | .82 | .46E | .56E | 6.47E |
| 1961 | T | .33 | .21 | .75 | 2.20 | .24 | .41 | 1.69 | 1.91 | 2.23 | .36 | .34 | 10.67 |
| 1962 | .20 | .14 | .36 | .70 | 2.02 | 3.08 | 1.59 | 3.58 | 1.65 | .43 | .25 | .21 | 14.21 |
| 1963 | .94 | .44 | .27 | 2.75 | 2.33 | 3.57 | .64 | .39 | 1.22 | .68 | .55 | .55 | 14.33 |
| 1964 | .10 | .06 | .20 | 2.58 | 2.50 | 3.30 | .14 | 1.54 | .01 | .57 | .69 | .55 | 11.97 |
| 1965 | 1.26 | .13 | .35 | .52 | 1.49 | 2.86 | 1.13 | 1.49 | 1.33 | 0 | .05 | .16 | 10.77 |
| 1966 | .09 | .32 | .14 | 2.36 | .77 | 1.87 | .28 | .43 | 1.06 | .98 | .32 | .49 | 9.11 |
| 1967 | .30 | .46 | .50E | 1.86 | 1.04 | 7.65 | .27 | .29 | 1.07 | .53 | .30 | .67 | 14.94E |
| 1968 | .66E | .45 | .78 | .19 | 1.69 | 5.58 | 1.19 | 3.44 | 1.93 | .51 | .53 | .64 | 17.59E |
| 1969 | .84 | .10 | .64E | 1.63 | .94 | 3.07 | 1.34 | .16 | .07 | .95 | .67 | .06 | 10.47E |
| 1970 | .76E | .26 | 1.05 | 1.77 | 4.20 | 1.09 | .43 | .00 | 1.58 | .79 | .89 | .26 | 13.08E |
| 1971 | 1.05 | .58 | .52 | 3.13 | 2.55 | .70 | .27 | .56 | .60 | 2.87 | .36E | .58 | 13.77E |
| 1972 | 1.06 | .34 | .86 | .65 | 2.10 | 2.08 | 2.36 | 1.15 | 1.35 | .92 | .19 | .29 | 13.35 |
| 1973 | .18 | .07 | .81 | 2.43 | .69 | 1.54 | .41 | .36 | 3.29 | .33 | .52 | .71 | 11.34 |
| 1974 | .62 | .31 | .89E | 1.78 | 2.37 | .87 | .80 | .76 | 1.70 | 3.00 | .95 | .30 | 14.35E |
| Avg. Month | .47 | .34 | .55 | 1.37 | 1.80 | 2.30 | .93 | 1.05 | 1.07 | .96 | .49 | .40 | 11.79yr |
| Yrs of record | 25 | 24 | 24 | 24 | 24 | 25 | 26 | 26 | 25 | 24 | 25 | 25 | 23 |
| Median value(in) | .31 | .34 | .52 | 1.11 | 1.89 | 2.08 | .63 | .76 | 1.07 | .78 | .52 | .34 | 11.34 |
| Record low (in) | T | .06 | .14 | .19 | .43 | .24 | 0 | 0 | .01 | 0 | .05 | .06 | 6.47 |
| Record high (in) | 1.26 | .62 | 1.05 | 3.13 | 4.20 | 7.65 | 3.46 | 3.58 | 3.29 | 3.00 | .95 | 1.03 | 17.59 |
| Range (in) | 1.26 | .56 | .91 | 2.94 | 3.77 | 7.41 | 3.46 | 3.58 | 3.28 | 3.00 | .90 | .97 | 11.12 |

2. Air-resource calculations (Modified from VTN Colorado, 1975b)

a. Fugitive-dust emissions

Fugitive-dust emissions from surface-mining operations are essentially a function of the amount of soil acreage disturbed and the overburden and topsoil removal and retrieval systems. Other factors to be considered include type of soil, soil-moisture content, wind conditions, and activity index. To obtain total particulate emissions, modified fugitive-dust emission factors can be applied to the removal and replacement of topsoil, to removal and handling of overburden, to coal-mining rates, and to wind erosion of unreclaimed spoils piles.

Estimated uncontrolled particulate emissions in the proposed mine areas were determined from formulas developed by the Midwest Research Institute (1974), with the exception of the factor for overburden re-contouring which was taken from work performed by PEDCo Environmental Specialists (U.S. Environmental Protection Agency, 1973). Although neither of these reference sources are directly concerned with surface mining, approximate adjusted emission factors were assumed in the absence of specific data for surface-mining operations. Order-of-magnitude dust discharge into the atmosphere has been calculated for the various mining operations, although it should be noted that no general agreement exists as to the validity of the results obtained. These uncontrolled discharges of dust are summarized on an annual basis in tables 36 and 41. Typical surface-mining operations that could cause deterioration of air quality are described below in sequence. It is assumed that similar operations would be used for both proposed Decker mines.

(1) Topsoil removal

Self-loading types of scrapers would be used to remove and transport the topsoil to a storage area. The greatest intensity of dust emissions occurs during loading and unloading of the transport vehicles. Dust emissions, which depend largely on moisture content and soil-type differences, can be approximated by utilizing a formula designed for agricultural dust emissions during tilling. These emissions are similar to those caused by soil disturbances during surface mining.

$$E = \frac{1.4 S (V/5.5)}{(PE/50)^2}$$

where: E = emission factor in pounds of dust/acre soil disturbed

S = silt content of surface soil (assume 50 percent)

$$E = \frac{1.4 (50) (5/5.5)}{(44/50)^2}$$

V = implement speed (assume 50 mph)

E = 82 pounds dust per acre soil disturbed

PE = Thornthwaite's precipitation index = 44

To calculate annual dust emissions from soil disturbances in the North Extension area, for example, assume that an average of 67 acres of topsoil would be removed or disturbed per year.^{1/} Using an adjusted value of 82 pounds of dust/acre of topsoil disturbed, the annual emission rate would be:

$$\text{Emission} = \frac{82 \text{ lb}}{\text{acre}} \times 67 \text{ acres} \times \frac{1 \text{ ton}}{2,000 \text{ lb}} = 2.75 \text{ tons/yr}$$

^{1/}

A total area of 1,340 acres would be mined over a period of 20 years, which is an annual rate of 67 acres/yr.

or, rounding to a whole number, 3 tons/yr (similar for topsoil replacement). Similar calculations for the East Decker mine, where an average of about 130 acres would be disturbed each year, indicate a rate of about 5 tons/yr.

(2) Overburden and coal removal

After the topsoil is removed, the overburden in turn must be removed to expose the coal seam. Some blasting is generally necessary to fracture the overburden. Because blasting-emission data are unavailable, no attempt has been made to quantify these emissions. The overburden would be removed by dragline, with the spoil being deposited in the previously mined boxcut. A composite emission factor of 0.05 pounds dust per ton of overburden was applied on the basis of data from an EPA study (John A. Green, Regional Administrator, EPA, written communication, December 14, 1976).

Coal would be mined using electric shovels with a front-end loader as a backup to the shovels. An emission factor of 0.05 pound per ton of coal mined was applied (John A. Green, Regional Administrator, EPA, written communication, December 14, 1976).

(a) Overburden removal

Assume for the North Extension mine that an average of 8.07 million tons of overburden are removed per year on the basis of an overburden ratio of 3.51 tons/ton of coal.

$$\text{Emissions} = 0.05 \text{ lb/ton} \times 8.07 \times 10^6 \text{ tons/yr} \times \frac{1 \text{ ton}}{2,000 \text{ lb}}$$

Emissions = 202 tons/yr (or 200 tons/yr when rounded to two significant figures)

Similar calculations for the proposed East Decker mine indicate a rate of about 590 tons/yr.

(b) Coal removal

Assume for the North Extension mine that an average of 2.3 million tons of coal are mined per year:

$$\text{Emissions} = 0.05 \text{ lb/ton} \times 2.3 \times 10^6 \text{ tons/yr} \times \frac{1 \text{ ton}}{2,000 \text{ lb}}$$

$$\text{Emissions} = 57 \text{ tons/yr}$$

Similar calculations for the proposed East Decker mine indicate a rate of about 170 tons/yr.

(3) Wind erosion of spoil piles prior to recontouring and topsoil placement

Wind erosion of unvegetated spoil piles prior to reclamation is estimated to be about 3.5 pounds per acre per day (Midwest Research Institute, 1974, table VII, p. 20). Assuming that reclamation would approximately keep pace with mining, the area of unvegetated spoil piles at any time should approximate the annual mining rate of about 67 acres per year in the North Extension area and about 130 acres per year in the East Decker area.

$$\text{Emissions} = 3.5 \text{ lb/acre/day} \times 365 \text{ days/yr} \times 67 \text{ acres} \times \frac{1 \text{ ton}}{2,000 \text{ lb}}$$

$$\text{Emissions} = 43 \text{ tons/yr}$$

Similar calculations for the proposed East Decker mine indicate a rate of about 83 tons/yr.

(4) Overburden recontouring and topsoil replacement

Bulldozers and scrapers would probably be used to recontour the overburden spoil piles prior to the replacement of topsoil. This activity is expected to cause some dust emissions. An emission factor of 1.12 tons per acre, which was developed for highway construction activity (U.S. Environmental Protection Agency, 1973), was selected. This factor compares favorably with similar factors determined for construction and earth-moving activities, which were found to be in the range of 1-2 tons of dust per acre disturbed (Midwest Research Institute, 1974).

Before revegetation, the topsoil is transported from its storage area, distributed in the mine area, and contoured. The fugitive dust emissions are similar to those involved in topsoil removal. A factor of 82 pounds per acre can be applied.

(a) Overburden recontouring

Assume that an average of 67 acres are recontoured per year at the proposed North Extension mine:

$$\text{Emissions} = 1.12 \text{ tons/acre} \times 67 \text{ acres/yr}$$

$$\text{Emissions} = 75 \text{ tons/yr}$$

Similar calculations for the proposed East Decker mine indicate a rate of about 150 tons/yr.

(b) Topsoil replacement

Assume an average of 67 acres of topsoil are replaced per year for the proposed North Extension mine.

$$\text{Emission} = 82 \text{ lb/acre} \times 67 \text{ acres} \times \frac{1 \text{ ton}}{2,000 \text{ lb}}$$

Emissions = 2.8 tons/yr (or 3 tons/yr when rounded to a whole number).

Similar calculations for the proposed East Decker mine indicate a rate of about 5 tons/yr.

(5) Vehicle dust on unpaved roads

The remaining significant fugitive dust source to be considered is that caused by vehicular traffic on unpaved haul roads. Coal haulage trucks would pulverize the haul-road surfaces and create a layer of fine dust. A conservative emission factor of 11 pounds per vehicle-mile was applied to average two-way haul distance for the coal.

The following formula was utilized to calculate the emission factor for fugitive dust generated by vehicle traffic on unpaved roads:

$$E = 0.81 S (V/30) \quad \text{where: } S = \text{silt content of surface material (assume 20 percent)}$$

$$E = 0.81 (20) (20/30) \quad V = \text{average vehicle speed (assume 20 mph)}$$

$$E = 11 \text{ pounds of dust per vehicle-mile traveled}$$

Assume that the average round-trip haul distance for coal from the active pits at the proposed North Extension mine to the truck-dump at the West Decker mine would be 4 miles. Annual haulage using 150-ton trucks to transport 2.3 million tons of coal would require about 15,300 trips per year, or about 61,000 vehicle-miles.

$$\text{Emission} = 11 \text{ lb/veh-mile} \times 61,000 \text{ veh-mile/yr} \times \frac{1 \text{ ton}}{2,000 \text{ lb}}$$

Emission = 335 tons/yr (or 340 tons/yr when rounded to two significant figures).

Similar calculations for the proposed East Decker mine, assuming an average round-trip haul distance of about 3 miles or a total of about 134,000 vehicle-miles annually, indicate a rate of about 740 tons/yr.

b. Coal processing emissions

Particulates or coal dusts are the primary pollutant emissions from the coal-processing operation. The coal would be dumped from the trucks into a sunken hopper, which overlies the underground primary crusher. From the primary crusher, the coal would be conveyed to a secondary crusher where it would be reduced to approximately two inches in size. Finally, the coal would be conveyed to concrete storage silos or loaded directly onto a unit train. An emission factor of 0.1 pounds of particulate per ton of coal was used for the crushing operation (U.S. Environmental Protection Agency, 1973). Conveying the coal also generates dust. An emission factor of 0.6 pounds per ton handled was applied to these operations. These two factors were applied to the annual coal output. Uncontrolled coal-processing particulate emission estimates for the North Extension mine would be:

$$\text{Emissions} = (0.1 + 0.6) \text{ lb/ton} \times 2.3 \times 10^6 \text{ tons/yr} \times \frac{1 \text{ ton}}{2,000 \text{ lb}}$$

Emissions = 805 tons/yr (800 tons/yr when rounded to two significant figures).

Similar calculations for the proposed East Decker mine indicate a rate of about 2,300 tons/yr.

c. Vehicular and equipment exhaust emissions

In addition to the particulate emissions contributed by fugitive dust, particulates and gaseous emissions such as CO, HC, NO_x and SO_x would be emitted from the various diesel-powered mining equipment and from the onsite haulage trucks. Table C-2 lists the pollutant emission factors for heavy-duty diesel trucks. Specific operating modes and ratings are lacking for the front-end loaders, scrapers, and bulldozers. It is assumed that the emissions from onsite haulage trucks would represent approximately 50 percent of the total emissions from site machinery.

Table C-2.--Pollutant emission factors for diesel trucks (U.S. Environmental Protection Agency, 1973)

| <u>Pollutant</u> | <u>Emission factor</u> (grams per vehicle-mile) |
|------------------|----------------------------------------------------|
| Particulates | 1.2 |
| Carbon monoxide | 20.4 |
| Hydrocarbons | 3.4 |
| Nitrogen oxides | 34.0 |
| Sulfur oxides | 2.4 |

Tables 37 and 42 summarize the estimated annual emissions from the diesel exhaust of mine equipment. These values were determined by applying the above emission factors to an average of 61,000 vehicle-miles per year for the proposed North Extension mine and 134,000 vehicle-miles per year for the proposed East Decker mine.

d. Unit train emissions

Particulates and gaseous pollutants are also discharged from diesel locomotive exhaust. Pollutant emission factors for diesel locomotives expressed as a function of fuel consumption are listed in table C-3. These factors are based on nationwide statistics. Calculation of gross emissions from the unit trains that would transport the coal from the mines to the user areas was based on several assumptions: For the proposed North Extension Mine, it was assumed that 230 unit trains per year would be needed to transport the approximately 2.3 million tons of coal that would be mined annually. Each train would be composed of five locomotives rated at 3,000 horse-power (HP) each for a full load. Each train would have 100 cars, each car carrying 100 tons of coal. Fuel consumption was assumed to be 5 gallons per hour (gal/hr) at idle and 152 gal/hr at full load. Each car weighs 30 tons empty. The average speed was assumed to be 20 miles per hour, and about one hour would be needed to make the one-way trip over the approximately 20-mile-long spur line.

Table C-3.--Average locomotive emission factors, (U.S. Environmental Protection Agency, 1973)

| <u>Pollutant</u> | <u>Emission factor</u> ^{1/} (Pounds per 1,000 gallons of fuel) |
|------------------|----------------------------------------------------------------------------|
| Particulates | 25 |
| Carbon monoxide | 130 |
| Hydrocarbons | 94 |
| Nitrogen dioxide | 370 |
| Sulfur dioxide | 57 |

^{1/}Based on nationwide statistics.

(1) Train-power requirements

For the proposed North Extension mine, train-power requirements were calculated as follows:

(1) Full train power:

$$230 \text{ trips/yr} \times 5 \text{ engines} \times 3000 \text{ HP/engine} \times 1 \text{ hr/trip} = \\ 3.5 \times 10^6 \text{ HP hrs/yr}$$

(2) Empty train power:

$$\frac{300 \text{ ton engine} + (100 \text{ cars} \times 30 \text{ tons/car})}{300 + 3,000 + (100 \text{ cars} \times 100 \text{ tons})} = 0.25 \text{ of full train power}$$

$$3.5 \times 10^6 \text{ HP hrs/yr} \times 0.25 = 8.7 \times 10^5 \text{ HP hrs/yr}$$

(3) Switching and idling activity:

Assuming 20 percent of full and empty train power

$$[(3.5 \times 10^6) + (8.7 \times 10^5)] \times 0.20 = 8.7 \times 10^5 \text{ HP hrs/yr}$$

$$\text{Total} = 5.2 \times 10^6 \text{ HP hrs/yr}$$

Similar calculations for the proposed East Decker mine indicate:

$$\text{Full train power} - 10.0 \times 10^6 \text{ HP hrs/yr}$$

$$\text{Empty train power} - 2.5 \times 10^6 \text{ HP hrs/yr}$$

$$\text{Switching and idling activity} - 2.5 \times 10^6 \text{ HP hrs/yr}$$

$$\text{Total} - 15.0 \times 10^6 \text{ HP hrs/yr}$$

(2) Yearly fuel requirements

For the proposed North Extension mine, annual fuel use in trains may be calculated as follows:

$$5.2 \times 10^6 \text{ HP hrs/yr} \times 152 \text{ gal/3,000 HP/hr} = 2.6 \times 10^5 \text{ gal/yr}$$

The emission factors presented in table C-3 were applied to the above fuel requirements to obtain the estimated train emissions resulting from coal transport from the North Extension mine over the approximately twenty-mile spur line (see table 43).

Similar calculations for the proposed East Decker mine indicate annual fuel use in trains to be about 7.6×10^5 gal/yr. See table 38 for estimated train emissions resulting from coal transport from the East Decker mine.

Table C-4.--1973 total suspended particulate readings for the Carlat Ranch station,
Decker, Montana (data from records of Air Quality Bureau, Montana
Department of Health and Environmental Sciences)

| Date | Reading (ug/m ³) | Quarterly Geo. Ave. (ug/m ³) | Daily Rainfall (Inches) | | | Monthly Rain- fall (Inches) | | | | |
|---------|---------------------------------|---------------------------------------------|-------------------------|-------------|-------------|--------------------------------|-----|------|------|------|
| | | | Sample Day | 1 Day Prev. | 2 Day Prev. | | | | | |
| Jan. 1 | 3.6 | 6.9 | .09 | T | .04 | 0.18 | | | | |
| 3 | 4.8 | | | | | | | | | |
| 9 | 6.0 | | | | | | | | | |
| 15 | 4.8 | | | | | | | | | |
| 21 | 3.6 | | | | | | | | | |
| 27 | 2.4 | | .04 | | | | | | | |
| Feb. 8 | 14.5 | | T | | .04 | 0.07 | | | | |
| 14 | 9.6 | | | | .03 | | | | | |
| 20 | 7.2 | | | | | | | | | |
| 26 | 7.2 | | | | | | | | | |
| Mar. 3 | 19.3 | | | | | | | | | |
| 10 | 42.2 | | | .37 | 0.81 | | | | | |
| 16 | 7.2 | | | | | | | | | |
| 22 | 2.4 | | | | | | | | | |
| 28 | 8.4 | | | | | | | | | |
| Apr. 9 | 9.6 | | | | | .03 | .39 | .43 | 2.43 | |
| 15 | 19.3 | | .55 | | | | | | | |
| 21 | 8.4 | | | .46 | | | | | | |
| 27 | 7.2 | | | | | | | | | |
| May 3 | 18.1 | .05 | | | | | | | | 0.69 |
| 9 | 27.7 | | | | | | | | | |
| 15 | 41.0 | | | | | | | | | |
| 27 | 18.1 | | .18 | | | | | | | |
| Jun. 8 | 36.2 | | .07 | .08 | | | | 1.54 | | |
| 14 | 28.9 | | | | | | | | | |
| 20 | 20.5 | | | | | | | | | |
| 26 | 38.6 | | | | | | | | | |
| Jul. 2 | 26.5 | 19.7 | | | | | | | 0.41 | |
| 14 | 53.0 | | | | | | | | | |
| 26 | 26.5 | | .03 | | | | | | | |
| Aug. 7 | 34.9 | | .05 | .06 | | | .09 | 0.36 | | |
| 13 | 31.3 | | | .16 | | | | | | |
| 19 | 38.6 | | | | | | | | | |
| 25 | 36.2 | | | | | | | | | |
| 31 | 18.1 | | | | | | | | | |
| Sep. 12 | 27.7 | 28.7 | | | | 3.29 | | | | |
| 18 | 16.9 | | | | | | | | | |
| 30 | 22.9 | | | | | | | | | |
| Oct. 12 | 9.6 | | | | | | .28 | | | 0.33 |
| 18 | 30.7 | | | | | | | | | |
| 24 | 26.5 | | | | | | | | | |
| 30 | 37.4 | | | | | | | | | |
| Nov. 12 | 12.1 | No November Data | | | | | | | | |
| 27 | 18.1 | 20.5 | No December Data | | | | | | | |
| 30 | 24.1 | | | | | | | | | |
| Dec. 12 | 20.5 | | | | | | | | | |

Annual Geo. Ave. 15.4

Table C-5.--1976 total suspended particulate readings for the Morton station, Decker,
Montana (data from records of Air Quality Bureau, Montana
Department of Health and Environmental Sciences

| Date | Reading (ug/m ³) | Quarterly Geo. Ave. (ug/m ³) | Daily Rainfall (Inches) | | | Monthly Rain- fall (Inches) |
|------------------|---------------------------------|---------------------------------------------|-------------------------|-------------|-------------|--------------------------------|
| | | | Sample Day | 1 Day Prev. | 2 Day Prev. | |
| Jan. 10 | 236.2 | | | | | 0.30 |
| 25 | 19.3 | | | | | |
| 31 | 98.8 | | | | | |
| Feb. 6 | 34.9 | | | | | |
| 12 | 42.2 | | | | | |
| 18 | 85.6 | | | | | 0.05 |
| 25 | 61.5 | | | | | |
| Mar. 1 | 25.3 | | .20 | | .03 | |
| 7 | 21.7 | | | | | |
| 13 | 25.3 | | | | | 0.35 |
| 19 | 222.9 | 53.7 | | | | |
| Apr. 6 | 47.6 | | | | | |
| 11 | 118.0 | | | | | |
| 18 | 20.9 | | | .21 | .38 | 3.17 |
| 24 | 41.8 | | | | | |
| 30 | 81.2 | | | .42 | | |
| May 6 | 31.3 | | | .12 | | |
| 12 | 241.3 | | .34 | | | |
| 18 | 109.0 | | | | | 1.36 |
| 24 | 90.5 | | | | | |
| 30 | 20.9 | | .16 | | | |
| Jun. 11 | 194.9 | | | | | |
| 17 | 23.2 | | .45 | | .62 | |
| 23 | 206.5 | | .14 | | | 2.20 |
| 29 | 38.3 | 64.6 | | | | |
| Jul. 11 | 234.3 | | | | | |
| 17 | 46.4 | | | | | |
| 23 | 128.8 | | | | | 0.83 |
| 29 | 134.6 | | | | | |
| Aug. 4 | 81.2 | | | | | |
| 10 | 171.7 | | | | | |
| 16 | 161.2 | | | | | |
| 22 | 125.3 | | | | | 0.00 |
| 28 | 99.8 | | | | | |
| Sep. 3 | 187.9 | | | | | |
| 15 | 65.0 | | | | .05 | 1.20 |
| 21 | 40.6 | | | | | |
| 27 | 26.7 | 97.3 | | | .65 | |
| Oct. 3 | 74.2 | | | | | |
| 9 | 51.0 | | | | | |
| 21 | 42.9 | | | | | |
| 27 | 71.9 | | | | | |
| Nov. 2 | 95.1 | | | | | |
| 8 | 149.6 | | | | | |
| 14 | 95.1 | | | | | |
| 20 | 102.1 | | | | | |
| 26 | 109.0 | | | | | |
| Dec. 2 | 18.0 | | | | | |
| 14 | 55.0 | 69.2 | | | | |
| Annual Geo. Ave. | 70.2 | | | | | |

APPENDIX D

WATER RESOURCES

APPENDIX D

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WATER RESOURCES

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Method used to estimate inflow to mine openings

The estimates of inflow to the mine openings are based on the assumption that the total inflow would be derived from three principal sources. These are (1) interception of the flow of ground water through the aquifers to be exposed in the mine pits, (2) removal of ground water from the storage in those aquifers, and (3) induction of recharge from the Tongue River Reservoir. Another possible source of inflow is upward leakage of ground water from aquifers that underlie but are not exposed in the mine openings. The latter source of inflow was ignored in the estimates owing to the relatively small quantity of inflow that would result in comparison with that from the other major sources.

Method of calculation

The estimates of the amount of ground water inflow to be derived from the major sources are based on calculations using standard ground water flow equations. The amount of ground water to be intercepted by the mine openings was computed using the following form of Darcy's law.

$$Q_f = TI_n W \quad (1)$$

Where

Q_f = quantity of water intercepted by mine opening in
ft³/d

T = transmissivity of the exposed aquifer in ft²/d

I_n = natural hydraulic gradient

W = width of mine opening normal to the natural gradient,
in ft.

The removal of ground water from aquifer storage was calculated using two equations; one to compute the radial component of inflow to the ends of the initial box cut and another to compute the linear component of inflow to the longitudinal sections of the box cuts.

The radial inflow to each end of the box was calculated using the constant drawdown-variable discharge equation derived by Jacob and Lohman (1952) in which

$$T = \frac{Q_s}{2\pi G(\alpha)s} \quad (2)$$

$$\text{or } Q_s = 2\pi T G(\alpha)s \quad (3)$$

$$\text{where } \alpha = \frac{Tt}{Sr_w^2} \quad (4)$$

and Q_s = quantity of water derived from radial inflow
from aquifer storage, in ft³/d

T = transmissivity of the exposed aquifer in ft²/d

S = coefficient of aquifer storage (dimensionless)

t = time since discharge began, in days

s = change in water level in the mine opening, in ft

r_w = radius of mine opening, in ft; equal to one half
the width of the initial box cut

$G(\alpha)$ = the G function of α (See Lohman, 1972, p. 23)

The linear portion of the inflow from aquifer storage was calculated using the constant drawdown - variable discharge drain equation derived by Stallman (Lohman, 1972, P. 41-43) in which

$$q_s = \frac{2 s \sqrt{ST}}{\sqrt{\pi t}} \quad (5)$$

where q_s = discharge of an aquifer from both sides of a drain per unit length of drain, in ft^2/d
 S = coefficient of aquifer storage (dimensionless)
 s = abrupt change in water level, in ft.
 T = transmissivity of the exposed aquifer in ft^2/d
 t = time since change in drain stage, in days

As both equations, 3 and 5, are based on the assumption, among others, that the aquifer is artesian (bounded above and below by impermeable strata) an adjustment was made to enable the use of these equations for water table conditions. According to M. I. Rorabaugh (U.S. Geological Survey, oral communication) a suitable adjustment is to replace the constant drawdown term, s , with $s_0 - \frac{s_0^2}{2b}$

where s_0 = observed change in water level in the mine pit
 b = saturated thickness of the exposed aquifer prior to mine construction and dewatering

The induction of recharge from the Tongue River Reservoir was also calculated using separate equations to compute the components of radial and linear inflow. Steady radial inflow to the ends of the box cuts from the reservoir was calculated using an equation derived from the Dupuit assumptions (Todd, 1959, P. 84) in which

$$Q_r = \pi K \frac{h^2}{\ln r_o/r_w} \quad (6)$$

where Q_r = radial inflow from the reservoir in ft^3/d

k = hydraulic conductivity of the exposed aquifer in ft/d

h = difference in head between the stage of the reservoir and the bottom of the aquifer exposed in the mine

r_o = distance from point of withdrawal to source of recharge in ft.

r_w = radius of well or opening from which water is discharging (equal to 1/2 width of the box cut), in ft.

Linear inflow of induced recharge from the reservoir was calculated using the expression (Todd, 1959, p. 80).

$$q_r = \frac{k}{2x} h^2 \quad (7)$$

where q_r = inflow through an aquifer from a line source to a line sink per unit length of drain, in ft^2/d

k = hydraulic conductivity of the aquifer in ft/d

h = difference in head between the stage of the reservoir and the water level in the mine

x = distance from line source to line sink (equal to the distance from the reservoir to the mine opening), in ft.

Procedure

To simplify the calculations and make them internally consistent, the following step-wise procedure was used.

1. Cross-sections were prepared to show the geologic and hydrologic features along the centerline of the initial box cuts using geologic data supplied by the Decker Coal Co. and hydrologic data from the Montana Bureau of Mines (Van Voast, 1974; Van Voast and Hedges, 1975) and the U.S. Geological Survey (N. J. King, written comm.).

2. The cross-sections were subdivided into segments having uniform or nearly uniform hydraulic properties; for example, similar aquifer materials and saturated thicknesses.

3. The time required to excavate each segment of the initial box cut was estimated on the basis of the relative thickness of overburden material to be moved and length of the segment. The average rate of excavation was assumed to be 30 feet per day.

4. Values for the hydraulic conductivity, K, and the coefficient of aquifer storage, S, were assigned for each aquifer to be exposed in the box cuts. The aquifers and the hydraulic conductivities and storage coefficient assigned are as follows:

| <u>Aquifer</u> | <u>Hydraulic conductivity</u> | <u>Storage coefficient</u> |
|----------------|-------------------------------|----------------------------|
| Clinker | 150-200 ft/d | 0.10 |
| Alluvium | 50-100 ft/d | 0.20 |
| Coal beds | 3-5 ft/d | 10^{-5} |

5. The dimensions and hydraulic variables were determined for each segment of the initial box cuts including the horizontal length, saturated thickness of the aquifer, b ; the differences in head, h , between the average high reservoir stage (3,420 ft above msl) and the level of the bottom of the aquifer where exposed in the mine pit; the distance, x , from the mine pit to the reservoir shore line, and the drawdown, s , to be imposed by mine dewatering.

6. The time after dewatering starts when the presence of a recharging boundary (reservoir shoreline) will affect the mine inflow was determined. According to M. I. Rorabaugh (U.S. Geological Survey, oral communication), the presence of a recharging boundary will begin to influence the mine inflow

$$\text{when } \frac{Tt}{a^2 s} = 0.2 \quad (8)$$

where T = transmissivity of the aquifer in ft^2/d

t = time since discharge began, in days

a = effective distance to recharging boundary in feet

s = coefficient of storage (dimensionless)

7. All lengths, thicknesses, times of construction, and other hydraulic variables were tabulated for each segment of the initial box cuts.

8. The inflows of ground water from each of the three major sources were calculated for each segment of the initial mine opening using the equations previously described and substituting appropriate values for each variable. Separate sets of calculations were made to compute the rate of pumping that would be required to keep the mine dewatered at the time each segment of the box cut is completed. To approximate most closely the geometry of the flow system, two adjustments were necessary to compute the total quantity of mine inflow at successive stages of construction. The first adjustment involved the radial inflow from storage to the ends of the box cuts and was made to compensate for the difference in age of the two ends of the cut. Using equation 3, calculations were made for two different values of t ; equivalent to the age of each end of the box cut. The results were then added together and divided by 2 to arrive at the total radial inflow from aquifer storage.

The second adjustment was necessary to compensate for the change-over from nonsteady to steady flow conditions on the reservoir side of the mine openings. This adjustment was made by calculating the steady state radial and linear inflows from the reservoir using equations 6 and 7. Next, the radial and linear inflows from aquifer storage were calculated using equations 3 and 5 and a value for t corresponding to the time of interception of the recharging boundary as determined from equation 8. To obtain the amount of linear inflow from storage derived from the reservoir side of the mine opening, equation 5 was solved using a value for s equivalent to h and dividing the result by 2 to represent the inflow from one side of the drain.

For the purpose of differentiating between inflows from storage and from induced recharge, it was assumed that the changeover from nonsteady radial or linear flow to steady-state radial or linear flow would require about one log cycle of time. For example, if the time of interception of the recharging boundary was computed from equation 8 to be 25 days then the changeover to steady-state conditions would be completed by the 250th day of pumping to dewater the mine. Moreover, during the changeover period, the amount of recharge induced by dewatering operations would increase from zero at the beginning of the changeover period to 100 percent of the flow under steady-state conditions at the end of the changeover period. To compensate for this changing flow condition a percent adjustment factor was obtained from the expression

$$P_f = \log_{10} t_x - \log_{10} t_1 \quad (9)$$

in which

P_f = percent adjustment factor

t_x = elapsed time since pumping began

t_1 = time of interception of recharging boundary

The percent adjustment factor was then multiplied by the values obtained from solving equations 6 and 7 to determine the amount of radial and linear inflow from induced recharge. The total amount of radial and linear inflow from both induced recharge and aquifer storage at any time, t_x during the changeover period was determined by the expression

$$Q_t = (Q_s - Q_r) (1 - P_f) + Q_r \quad (10)$$

where

Q_t = total inflow at time

Q_s = inflow from aquifer storage at time t_1
(beginning of changeover period)

Q_r = inflow from induced recharge under steady
state conditions

P_f = percent adjustment factor

The inflow from aquifer storage was obtained by subtracting the inflow from induced recharge at time t_x from the total inflow at time t_x .

Table D-1.--Wells in the Decker area, Big Horn County, Montana, and Sheridan County Wyoming

Location: See fig O-1 for description of well numbering system. Location interpreted from Decker Coal Co. maps, scale 1:6,000, in mine project areas; elsewhere, interpreted from U.S. Geological Survey 7½-min quadrangle topographic maps, scale 1:24,000. Altitude of land surface: Distance above mean sea level. Interpreted from Decker Coal Co. maps, contour interval of 5 ft, in mine project areas; accurate to 5 ft. Elsewhere, interpreted from U.S. Geological Survey topographic maps, contour interval of 20 ft; accurate to 10 ft.

Depth of well: Measured below top of casing. R, indicates reported depth.

Aquifer: An coal, Anderson coal; Dz 1 coal, Dietz 1 coal, Dietz 2 coal; Can coal, Canyon coal; Sub Dz 2, aquifer below Dietz 2 coal; An-Dz 1 coal, Anderson-Dietz 1 coal combined; An-Dz 1-Dz 2 coal, Anderson-Dietz 1-Dietz 2 coal combined; Dz 1-Dz 2 coal;

Dietz 1-Dietz 2 coal combined; An-Ovb, Anderson coal overburden; An-Dz 1 Ovb, Anderson-Dietz 1 coal combined overburden; An clinker, clinker formed by burning of the Anderson coal; An-Dz 1 clinker, clinker formed by burning of the Anderson-Dietz 1 coal combined; Dz 2 clinker, clinker formed by burning of the Dietz 2 coal.

Water level: R, indicates reported data; MP, height of measuring point above (+) or below (-) land surface. Altitude of water level is distance above mean sea level.

Water quality: Field measurements on water sample pumped (P) or bailed (B) from well. Use of water: D, domestic; G, garden; I, industrial; P, public; S, livestock and wildlife; U, unused.

| No. | Location | | | Owner | Altitude of land surface (feet) | Depth of well (feet) | Aquifer | Date of measurement | Water level | | | Water quality | | | Use of water | Remarks |
|-----|-----------|-------|---------|-----------------------------|---------------------------------|----------------------|----------------------|---------------------|--------------|-----------|-----------------|--------------------------------------|------|------------------|--------------|-------------------------------------------------------------------------------------------|
| | Town-ship | Range | Section | | | | | | Depth (feet) | MP (feet) | Altitude (feet) | Specific conductance (micromhos/cm) | pH | Temperature (°C) | | |
| 1 | 8 S. | 39 E. | 12 ACBC | Joseph M. Pierce | 3,860 | 305 R | Sub Dz 2 coal | 7-18-74 | 138 R | -3.0 | 3,719 | 1,700 P | --- | 12.5 | D, S | Water analysis. Inside of casing wet. |
| 2 | 8 S. | 39 E. | 12 ACBC | -----do----- | 3,850 | 370 R | Sub Dz 2 coal | 7-18-74 | 175.7 | +1.0 | 3,675 | 2,440 P | --- | 12.0 | S | Water analysis. |
| 3 | 8 S. | 39 E. | 13 BBCC | -----do----- | 4,080 | 384 R | An-Dz 1-Dz 2 coal | 7-18-74 | 249 R | ---- | 3,831 | 3,500 P | --- | 10.0 | S | Do |
| 4 | 8 S. | 39 E. | 14 CBBD | Dominic Carboni | 3,810 | 1/1094 | An-Dz 1-Dz 2 coal(?) | 10-13-73 | 79.0 | +2.3 | 3,733 | 1,400 B | 7.8 | 10.5 | S | Do |
| 5 | 8 S. | 39 E. | 21 PCAB | Consolidation Coal Co. | 3,900 | 39.6 | Alluvium | 7-18-75 | 8.13 | + .2 | 3,892 | 1,800 B | 7.5 | 8.5 | S | Flow in nearby channel about 50 gal/min, specific conductance, 1675 micromhos/cm; pH, 70. |
| 6 | 8 S. | 39 E. | 22 DCCD | Pacific Power and Light Co. | 3,832 | 58.9 | Alluvium(?) | 10-11-73 | 19.06 | + .3 | 3,813 | 2,100 B | 7.7 | 9.5 | S | |
| 7 | 8 S. | 39 E. | 23 ABDA | -----do----- | 3,770 | 39.6 | Alluvium | 10-13-73 | 30.24 | +1.5 | 3,741 | 590 B | 7.4 | 9.5 | U | Water polluted. |
| 8 | 8 S. | 39 E. | 24 BBBB | -----do----- | 3,785 | 218.0 | Can coal(?) | 7-14-74 | 117.90 | + .7 | 3,668 | 1,800 B | 8.6 | ---- | S | |
| 9 | 8 S. | 39 E. | 24 BCDD | -----do----- | 3,740 | 105.1 | An-Dz 1-Dz 2 coal | 10-13-73 | 85.70 | + .65 | 3,655 | 2,300 B | 7.2 | 11.6 | U | Water polluted. |
| 10 | 8 S. | 39 E. | 25 DBDD | -----do----- | 3,665 | 44.5 | An-Dz 1-Dz 2 coal | 7-14-74 | 4.93 | -5.4 | 3,655 | 2,400 B | 7.7 | ---- | S | |
| 11 | 8 S. | 39 E. | 26 BDBA | Consolidation Coal Co. | 3,768 | ----- | Alluvium(?) | 10-11-73 | 16.85 | +1.0 | 3,752 | ----- | ---- | ---- | S | Inspection showed pump and casing had been removed and well had caved. |
| 12 | 8 S. | 39 E. | 27 CDCD | -----do----- | 4,095 | 54.3 | Smith coal | 10-12-73 | 36.34 | +1.1 | 4,060 | 1,000 B | 7.7 | 9.7 | S | |
| 13 | 8 S. | 39 E. | 32 DBCD | -----do----- | 3,900 | 1/294 | Alluvium(?) | 10-16-73 | 13.02 | -6.1 | 3,881 | 2,700 B | 7.9 | 10.0 | U | |
| 14 | 8 S. | 40 E. | 11 CAAC | R. Lee | 3,485 | 14 R | Alluvium | 7-18-74 | 2.3 | + .5 | 3,483 | 905 P | --- | 13.5 | S | Water analysis. |
| 15 | 8 S. | 40 E. | 15 DBAD | Panetta Bros. | 3,520 | ----- | Alluvium(?) | 10-18-73 | 27.3 | + .9 | 3,494 | 700 P | 7.2 | 9.5 | D | Numerous cottonwood trees in nearby channel. |
| 16 | 8 S. | 40 E. | 17 DDAA | -----do----- | 3,662 | 1/194 | Sub Dz 2 coal | 10-18-73 | 137.7 | +2.5 | 3,527 | 890 P | 7.8 | ---- | S | |
| 17 | 8 S. | 40 E. | 18 BBAD | Joseph M. Pierce | 3,845 | 303 R | Sub Dz 2 coal | 9-26-75 | 180 R | +2.5 | 3,668 | 660 P | 7.7 | ---- | S | |
| 18 | 8 S. | 40 E. | 22 BBCC | Bureau of Land Management | 3,620 | 275.7 | Unknown | 10-18-73 | 118.70 | + .35 | 3,502 | 610 B | 7.6 | 13.5 | U | |
| 19 | 8 S. | 40 E. | 28 ABDB | -----do----- | 3,543 | 107.3 | Dz 2 clinker | 10-11-73 | 80.97 | 0 | 3,462 | 950 B | 8.0 | 11.7 | S | |
| 20 | 8 S. | 40 E. | 31 ABDA | Pacific Power and Light Co. | 3,615 | 144.6 | Dz 2 coal | 10-11-73 | 97.22 | +1.0 | 3,519 | 1,750 B | 7.2 | 10.6 | S | |
| | | | | | | | | 7-18-75 | 96.86 | +1.0 | 3,519 | 1,475 B | 7.2 | 9.5 | S | |

Table D-1.--Wells in the Decker area, Big Horn County, Montana, and Sheridan County Wyoming--Continued

| No. | Location | | | Owner | Altitude of land surface (feet) | Depth of well (feet) | Aquifer | Date of measurement | Water level | | | Water quality | | | Use of water | Remarks |
|-----|-----------|-------|----------------------|--------------------------------|---------------------------------|----------------------|-------------------------------|---------------------|--------------|-----------|-----------------|-------------------------------------|-----|------------------|-----------------|-----------------------------------------------------------------------------------------------------------|
| | Town-ship | Range | Section | | | | | | Depth (feet) | MP (feet) | Altitude (feet) | Specific conductance (micromhos/cm) | pH | Temperature (°C) | | |
| 21 | 8 S. | 40 E. | 32 DAAD | Decker Coal Co. | 3,540 | 1/ 81+ | An-Dz 1 clinker | 7-18-75 | 47.19 | -4.8 | 3,488 | 1,440 P | 7.5 | ---- | D, S | |
| 22 | 8 S. | 40 E. | 33 ACDB | -----do----- | 3,487 | 80 R | Dz 2 coal | 10-11-73 | 55.79 | +1.0 | 3,432 | 1,700 P | 7.4 | 10.5 | | Water analysis. |
| | | | | | | | | 7-14-74 | 55.39 | +1.0 | 3,433 | ----- | --- | ---- | S | |
| | | | | | | | | 7-24-75 | 56.67 | +1.0 | 3,431 | P | 7.4 | 11.6 | S | Specific capacity, 0.05. |
| 23 | 8 S. | 40 E. | 33 BCDA | -----do----- | 3,515 | 88.5 | An-Dz 1 clinker and Dz 2 coal | 10-13-73 | 28.19 | + .2 | 3,487 | 1,525 P | 7.2 | 10.0 | S | |
| | | | | | | | | 7-19-75 | 26.77 | + .2 | 3,488 | 1,325 P | 6.9 | 10.4 | S | |
| 24 | 8 S. | 40 E. | 34 BDAA ₁ | -----do----- | 3,460 | 39.9 | An-Dz 1 clinker | 10-11-73 | 30.20 | 0 | 3,430 | 1,000 B | 7.9 | 11.6 | U | |
| | | | | | | | | 7-23-75 | 30.51 | 0 | 3,429 | ----- | --- | ---- | U | |
| 25 | 8 S. | 40 E. | 34 BDAA ₂ | -----do----- | 3,462 | 1/ 53+ | An-Dz 1 clinker(?) | 10-11-73 | 33.99 | +1.35 | 3,429 | 940 P | 8.0 | 11.9 | S, G | Water analysis. |
| | | | | | | | | 7-23-75 | 34.36 | +1.35 | 3,429 | 975 P | 8.0 | 11.5 | S, G | Specific capacity, 56.4. |
| 26 | 8 S. | 40 E. | 34 DBBA | -----do----- | 3,444 | 97.6 | Dz 2 coal | 10-12-73 | 13.41 | 0 | 3,430 | 920 B | 7.6 | 11.0 | U ^{2/} | Low yield inadequate for domestic use. |
| | | | | | | | | 7-23-75 | 13.85 | 0 | 3,430 | 900 B | 7.4 | 10.7 | U | |
| 27 | 8 S. | 41 E. | 21 CAB | -----do----- | 3,733 | 99.8 | An coal(?) | 10-17-73 | 82.49 | + .8 | 3,651 | 760 P | 7.9 | ---- | S | Water analysis. |
| 28 | 8 S. | 41 E. | 24 DCBA | H. A. Porter | 3,970 | 43.1 | Sandstone(?) | 10-14-73 | 16.95 | +1.4 | 3,954 | 4,500 B | 7.4 | 13.9 | S | Well in valley bottom downstream from reservoir. |
| 29 | 8 S. | 41 E. | 25 CCAB | -----do----- | 4,150 | 420 R | Smith coal(?) | 10-14-73 | 388.6 | + .5 | 3,762 | 5,000 P | 8.2 | 13.5 | D, S | |
| 30 | 8 S. | 41 E. | 29 BAAC | Decker Coal Co. | 3,580 | 34.2 | An clinker | 7-13-74 | 17.34 | +1.0 | 3,564 | 2,890 B | 7.4 | 13.0 | S | Spring in nearby channel discharges less than 1 gal/min. |
| 31 | 8 S. | 41 E. | 32 BBBD | -----do----- | 3,635 | 196.5 | Dz 1-Dz 2 interburden(?) | 10-17-73 | 93.38 | + .4 | 3,542 | 6,500 P | 7.7 | 14.0 | S | |
| | | | | | | | | 7-13-74 | ----- | + .4 | ----- | 7,400 P | 7.4 | ---- | S | |
| 32 | 8 S. | 41 E. | 34 BOCC | Holmes Ranch | 3,670 | 182.9 | Dz 2 coal(?) | 10-14-73 | 87.41 | +2.0 | 3,585 | 3,000 B | 8.5 | 12.8 | S | |
| 33 | 9 S. | 39 E. | 14 ACBC | Consolidation Coal Co. | 3,660 | 30.9 | Alluvium | 10-17-73 | 10.54 | -5.1 | 3,644 | 1,950 P | 7.3 | 13.0 | S | |
| 34 | 9 S. | 39 E. | 14 BDAD | -----do----- | 3,655 | 300 R | An-Dz 1-Dz 2 coal | 10-17-73 | ----- | ----- | ----- | 1,500 P | 6.8 | 14.0 | D | Gelatinous substance in well clogged electric tape and prevented water level measurement. Water analysis. |
| 35 | 9 S. | 39 E. | 14 DCBB | -----do----- | 3,647 | 391.7 | Sub Dz 2 coal | 10-16-73 | 160.9 | + .5 | 3,487 | 4,700 B | 7.6 | 12.5 | U | Water entering well about 58 ft below land surface and flowing downward inside casing. |
| | | | | | | | | 7-18-74 | 163.2 | + .5 | 3,484 | 4,800 B | --- | 10.7 | U | |
| 36 | 9 S. | 39 E. | 22 CCBC | J. V. States | 4,035 | 615 R | Dz 1-Dz 2 coal(?) | 10-17-74 | 367±1 | + .9 | 3,669 | 2,750 B | 7.4 | ---- | S | Considerable gas blowing from well. Could not get accurate water level measurement. |
| 37 | 9 S. | 39 E. | 24 ACDB | Consolidation Coal Co. | 3,600 | 235 R | An-Dz 1-Dz 2 coal | 8-26-75 | 88 R | -6.0 | 3,506 | 2,950 P | 8.4 | 11.0 | D | Water has black color and strong odor of H ₂ S. |
| 38 | 9 S. | 39 E. | 24 DCDC | -----do----- | 3,608 | 244 R | An-Dz 1-Dz 2 coal | 8-26-75 | 106 R | -5.0 R | 3,497 | 2,950 P | 8.0 | ---- | D | |
| 39 | 9 S. | 39 E. | 25 DDAC | Clariss Foss and C. S. Trusler | 3,590 | 150 R | An Ovb | 10-16-73 | ----- | + .6 | ----- | ----- | --- | ---- | U | Well caved 16.6 ft below land surface. |
| 40 | 9 S. | 39 E. | 29 DBDA | J. V. States | 3,725 | 40.0 | Alluvium | 7-18-74 | 18.98 | +2.7 | 3,709 | 1,700 P | 7.4 | 11.4 | D, S | |
| 41 | 9 S. | 39 E. | 32 BAAA | School District(?) | 3,770 | 1/ 140+ | Dz 1-Dz 2 coal | 7-18-74 | 63.37 | -6.0 | 3,701 | ----- | --- | ---- | U | At site of old Pearl School. |
| 42 | 9 S. | 40 E. | 1 CDEB | Kendrick Cattle Co. | 3,446 | 126.1 | Dz 2 coal | 10-18-73 | 27.58 | +1.2 | 3,420 | 2,250 B | 9.7 | 11.5 | S | |
| | | | | | | | | 7-21-75 | 26.10 | +1.2 | 3,421 | 2,500 B | 9.8 | 9.4 | S | |

Table D-1.--Wells in the Decker area, Big Horn County, Montana, and Sheridan County Wyoming--Continued

| No. | Location | | | Owner | Altitude of land surface (feet) | Depth of well (feet) | Aquifer | Date of measurement | Water level | | | Water quality | | | Use of water | Remarks |
|-----|-----------|-------|---------|------------------------|---------------------------------|----------------------|--------------------------|---------------------|--------------|-----------|-----------------|-------------------------------------|-------|------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Town-ship | Range | Section | | | | | | Depth (feet) | MP (feet) | Altitude (feet) | Specific conductance (micromhos/cm) | pH | Temperature (°C) | | |
| 62 | 9 S. | 40 E. | 21 CDBD | M. C. Johnston | 3,573 | 180 R | An-Dz 1 coal | 10-12-73 | 145 | +1.8 | 3,430 | 1,675 P | 7.8 | ---- | D, P | Well pumped prior to measurement. Water level rising very slowly. Water analysis. |
| 63 | 9 S. | 40 E. | 21 DCBB | -----do----- | 3,560 | 275.5 | An-Dz 1 coal(?) | 7-13-74 | 147.6 | +1.8 | 3,427 | 1,675 P | 7.8 | ---- | D, P | Considerable dissolved gas in water. |
| | | | | | | | | 8-26-75 | ----- | ----- | ----- | ----- | ----- | D, P | | |
| 64 | 9 S. | 40 E. | 21 DBBA | Emmett Munson | 3,504 | 171 R | Sandstone in An-Dz 1 Ovb | 10-12-73 | 124.7 | +1.1 | 3,436 | 3,200 B | 8.0 | 10.4 | U ² | Apparent leakage from overlying aquifers. |
| | | | | | | | | 7-13-74 | 130.07 | +1.1 | 3,431 | ----- | ----- | ----- | ----- | |
| 65 | 9 S. | 40 E. | 22 DAAD | -----do----- | 3,460 | 170.5 | An coal | 7-20-75 | 132.73 | +1.1 | 3,428 | 2,700 B | 7.8 | 9.5 | U | Specific capacity, 9.1. |
| | | | | | | | | 10-15-73 | 31.62 | +1.9 | 3,474 | 5,300 P | 7.7 | 10.0 | S | |
| 66 | 9 S. | 40 E. | 22 DADA | -----do----- | 3,460 | 180 R | An coal | 7-13-74 | 31.79 | +1.9 | 3,474 | 5,750 P | 7.4 | ----- | S | Considerable dissolved gas in water; strong odor of H ₂ S. Water analysis. |
| | | | | | | | | 7-24-75 | 31.90 | +1.9 | 3,474 | 6,200 P | 7.4 | 10.8 | S | |
| 67 | 9 S. | 40 E. | 24 ABAB | Holmes Ranch | 3,530 | 76.1 | An Ovb | 10-18-73 | 41.79 | +1.1 | 3,419 | 2,900 P | 8.0 | 10.0 | S | Possible leakage from impoundment immediately upstream. |
| 68 | 9 S. | 40 E. | 24 ABBA | Decker Coal Co. | 3,528 | 140.1 | An coal | 8-23-75 | ----- | ----- | ----- | 2,750 P | 7.8 | ---- | D | |
| 69 | 9 S. | 40 E. | 26 BADD | Emmett Munson | 3,490 | 41.0 | Smith Ovb | 10-17-73 | 32.64 | +1.4 | 3,499 | 1,100B | 7.4 | 11.0 | S | Well flows about 5 gal/min. |
| | | | | | | | | 8-23-75 | 31.78 | +1.4 | 3,500 | 3,500 B | ---- | 10.2 | S | |
| 70 | 9 S. | 40 E. | 27 CCAC | James Muller | 3,440 | 260 R | An-Dz 1 coal | 7-15-74 | 45.16 | + .4 | 3,483 | 620 B | 7.5 | ---- | S | Well flows about 2 gal/min. |
| 71 | 9 S. | 40 E. | 28 DABC | -----do----- | 3,460 | 260 R | An-Dz 1 coal | 8-23-75 | ----- | ----- | ----- | 1,200 P | ---- | 10.7 | S | |
| 72 | 9 S. | 40 E. | 29 CCAD | James McCarthy | 3,525 | 151 R | An-Dz 1 coal | 10-19-73 | Flow | ----- | 3,445+ | 2,300 | ---- | 12.2 | D, S | Water analysis. |
| | | | | | | | | 10-19-73 | Flow | ----- | 3,462+ | 2,100 | ---- | 12.7 | S | |
| 73 | 9 S. | 40 E. | 29 DBDB | School District | 3,560 | ----- | An-Dz 1 coal(?) | 10-16-73 | 31 R | -8.0 | 3,486 | 1,750 P | ---- | ---- | D, P | Odor of H ₂ S. |
| | | | | | | | | 8-26-75 | ----- | ----- | ----- | 1,750 P | 7.8 | ---- | D, P | |
| 74 | 9 S. | 40 E. | 30 ABDD | Consolidation Coal Co. | 3,545 | ----- | An-Dz 1 coal | 10-16-73 | ----- | ----- | ----- | 1,900 P | 7.8 | ---- | P | Odor of H ₂ S. Pump set near bottom of well. Wet tape indicates downward movement of water from overburden into coal aquifer. This would explain poor quality of water. |
| | | | | | | | | 8-26-75 | ----- | -6.0 | ----- | 2,700 P | 7.4 | ---- | D, S | |
| 75 | 9 S. | 40 E. | 30 BBAC | -----do----- | 3,573 | 1/127+ | An-Dz 1-Dz 2 coal | 10-16-73 | 106.5 | +1.5 | 3,468 | 6,500 P | 7.8 | 10.0 | S | Odor of H ₂ S. |
| | | | | | | | | 7-24-75 | 108.7 | +1.5 | 3,466 | 8,000 P | 7.6 | 10.6 | S | |
| 76 | 9 S. | 40 E. | 36 AADC | Emmett Munson | 3,725 | 1/288+ | Smith coal | 10-18-73 | 190.2 | + .2 | 3,535 | 3,300 B | 9.6 | 14.0 | S | |
| | | | | | | | | 10-14-73 | 109.0 | +2.0 | 3,693 | 2,700 B | 7.0 | 11.1 | S | |
| 77 | 9 S. | 41 E. | 1 DADD | H. A. Porter | 3,800 | 180 R | Smith coal | 10-15-73 | 41.46 | 0 | 3,456 | 5,300 P | 6.4 | 10.0 | S | |
| 78 | 9 S. | 41 E. | 6 DDCD | Decker Coal Co. | 3,497 | 73+ | Alluvium(?) Dz 1 coal | 7-21-75 | 40.32 | 0 | 3,457 | 5,200 P | 7.5 | 11.0 | S | |
| 79 | 9 S. | 41 E. | 7 ADCA | -----do----- | 3,520 | 125 R | Dz 1 coal | 7-13-74 | 59.60 | -4.5 | 3,456 | 3,550 P | 7.8 | 13.0 | D, S | Odor of H ₂ S. |
| | | | | | | | | 8-24-75 | ----- | ----- | ----- | 3,600 P | ---- | ---- | D, S | |

Table D-1.--Wells in the Decker area, Big Horn County, Montana, and Sheridan County, Wyoming--Continued

| No. | Location | | Owner | Altitude of land surface (feet) | Depth of well (feet) | Aquifer | Date of measurement | Water level | | | Water quality | | | Use of water | Remarks |
|-----|-----------|-------|---------------------|---------------------------------|----------------------|---------------------|---------------------|--------------|-----------|-----------------|---------------------------------------------------|-----|------------------|--------------|---------------------------------------------------------------------------|
| | Town-ship | Range | Section | | | | | Depth (feet) | MP (feet) | Altitude (feet) | Specific conductance (micromhos/cm ²) | pH | Temperature (°C) | | |
| 80 | 9 S. | 41 E. | 7 CCBD | Decker Coal Co. | 3,513 | 103.2 An coal | 10-17-73 | 79.87 | + .7 | 3,434 | 2,100 B | 7.8 | ---- | U | Strong odor of H ₂ S. |
| 81 | 9 S. | 41 E. | 8 CACD | -----do----- | 3,540 | 68+ An coal | 8-25-75 | 78.98 | + .7 | 3,435 | 1,875 B | 7.6 | 11.7 | U | Do |
| 82 | 9 S. | 41 E. | 8 CDBD | -----do----- | 3,555 | 106.0 An coal | 7-17-75 | 46.85 | -5.6 | 3,488 | 2,950 P | 7.4 | ---- | D, S | Faint odor of H ₂ S. |
| 83 | 9 S. | 41 E. | 9 ACBC ₁ | Holmes Ranch | 3,515 | 29.7 Alluvium | 10-15-73 | 44.12 | +1.3 | 3,512 | 1,000 P | 8.0 | 10.3 | S | |
| 84 | 9 S. | 41 E. | 9 ACBC ₂ | -----do----- | 3,516 | 30 R Alluvium | 8-23-75 | 41.13 | +1.3 | 3,515 | 900 P | --- | 10.1 | S | |
| 85 | 9 S. | 41 E. | 14 ACCD | -----do----- | 3,622 | 63.0 Alluvium | 10-14-73 | 5.90 | +1.0 | 3,510 | 2,800 P | 7.5 | 10.5 | S | Water analysis. |
| 86 | 9 S. | 41 E. | 15 ABDA | -----do----- | 3,550 | 26.7 Alluvium | 8-25-75 | 6.45 | +1.0 | 3,510 | 2,700 P | --- | ---- | S | |
| 87 | 9 S. | 41 E. | 17 CBBD | -----do----- | 3,580 | 96.1 An Ovb | 7-15-74 | ----- | ---- | ----- | 2,640 P | 7.2 | ---- | D | |
| 88 | 9 S. | 41 E. | 26 AADA | -----do----- | 3,688 | 41.5 Alluvium | 8-25-75 | 6 R | ---- | 3,510 | 2,700 P | 7.4 | ---- | D | |
| 89 | 9 S. | 41 E. | 26 BABC | Willis W. Elder | 3,746 | 113.9 Smith coal(?) | 7-15-74 | 33.39 | + .8 | 3,589 | 4,050 B | 6.9 | ---- | S | |
| 90 | 9 S. | 42 E. | 5 AAAD | -----do----- | 3,891 | 134.1 Unknown | 10-15-73 | 5.42 | + .7 | 3,545 | 1,650(?)B | 8.0 | 10.5 | S | Saturation in nearby channel of Deer Creek. Well pumping about 7 gal/min. |
| 91 | 9 S. | 42 E. | 31 CBAC | H. A. Porter | 3,745 | 29.1 Alluvium | 8-24-75 | ----- | ---- | ----- | 4,000 P | --- | 9.5 | S | |
| 92 | 10 S. | 42 E. | 6 ABDD | -----do----- | 3,810 | 183.7 Unknown | 10-15-73 | 26.74 | + .4 | 3,554 | 3,300 B | 7.7 | 10.0 | S | |
| 93 | 58 N. | 81 W. | 19 AAAD | Allen Fordyce | 3,910 | ----- Unknown | 7-17-74 | 27.40 | + .4 | 3,553 | 3,700 B | 7.0 | ---- | S | |
| 94 | 58 N. | 81 W. | 20 AADD | -----do----- | 3,850 | ----- Unknown | 10-15-73 | 9.94 | + .6 | 3,679 | 4,700 B | 7.4 | 9.7 | S | |
| 95 | 58 N. | 82 W. | 23 CCBA | -----do----- | 3,777 | 145.3 Roland coal | 7-23-75 | 49.58 | +1.3 | 3,698 | 4,900 B | 7.4 | 10.5 | S | Apparently well has caved; depth originally 252 ft. |
| | | | | | | | 11-14-73 | 22.05 | + .3 | 3,869 | ----- | --- | ---- | S | |
| | | | | | | | 7-17-74 | 21.23 | + .3 | 3,870 | 2,300 B | 7.3 | ---- | S | |
| | | | | | | | 10-15-73 | 6.50 | + .8 | 3,739 | 4,700 B | 7.5 | 10.2 | S | |
| | | | | | | | 10-15-73 | 98.00 | +1.6 | 3,714 | 1,600 B | 8.3 | 10.2 | U | Well reported to be crooked. |
| | | | | | | | 6-6-74 | 187.0 | + .6 | 3,724 | 4,700 P | 6.5 | 10.0 | S | |
| | | | | | | | 6-6-74 | 97.1 | + .4 | 3,753 | 4,200 P | 6.5 | 10.5 | S | |
| | | | | | | | 6-6-74 | 50.68 | 0 | 3,726 | 2,500 B | --- | 11.6 | S | Water polluted |

¹/Depth to top of pump. Could not get total depth-of-well measurement.²/Well drilled by Decker Coal Co.³/Depth to water level greater than 95 feet. Tape would not pass obstruction at this depth.

Table O-2.--Observation wells in the West Decker area, Big Horn County, Montana

Location: See fig. D-1 for description of well-numbering system. Location of wells 11, 12 Depth of well: Measured below top of casing.
 and 18 interpreted from U.S. Geological Survey 7½-min quadrangle topographic maps, Aquifer: An-Dz 1 coal, Anderson-Dietz 1 coal combined; Dz 2 coal, Dietz 2 coal;
 scale 1:24,000. Location of other wells interpreted from Decker Coal Co. maps, An-Dz 1-Dz 2 coal, Anderson-Dietz 1-Dietz 2 coal combined. Identification of aquifer
 made by Montana Bureau of Mines and Geology.

| Number | Decker Coal Co. number | Montana Bureau of Mines number | Location | | Altitude of land surface (feet) | Depth of well (feet) | Aquifer | Date of measurement | Water level | | | Water quality | | | Remarks |
|--------|------------------------|--------------------------------|-----------|-------|---------------------------------|----------------------|-------------------|---------------------|-------------|--------------|-----------|-----------------|--------------------------------------|------|-------------------------------------------|
| | | | Town-ship | Range | | | | | Section | Depth (feet) | MP (feet) | Altitude (feet) | Specific conductance (micromhos/cm) | pH | |
| 1 | ----- | WR-3 | 9 S. | 40 E. | 8 DCAA | 209.5 | An-Dz 1 coal | 7-12-74 | 177.93 | 0.7 | 3,435 | 2,200 | 8.0 | 12.8 | Well has 1½-inch diameter plastic casing. |
| 2 | 335-72 | WR-14 | 9 S. | 40 E. | 9 BDD _{B1} | 195.7 | An-Dz 1 coal | 10-16-74 | 179.59 | .7 | 3,433 | ----- | --- | ---- | |
| | | | | | | | | 7-15-75 | 181.83 | .7 | 3,431 | 2,250 | 8.0 | 12.8 | |
| 3 | 334-72 | WR-13 | 9 S. | 40 E. | 9 BDD _{B2} | 250.0 | Dz 2 coal | 7-12-74 | 176.82 | .6 | 3,419 | 2,100 | 8.0 | 12.8 | |
| | | | | | | | | 10-16-74 | 177.67 | .6 | 3,418 | ----- | --- | ---- | |
| 4 | ----- | ----- | 9 S. | 40 E. | 9 BDD _{B2} | 89.2 | Mine spoils | 7-15-75 | 180.42 | .6 | 3,415 | 2,050 | 8.0 | 12.8 | |
| | | | | | | | | 7-16-74 | 157.50 | .8 | 3,435 | 1,975 | 7.7 | ---- | |
| 5 | ----- | ----- | 9 S. | 40 E. | 15 CDBD ₁ | 98.5 | Mine spoils | 10-16-74 | 156.94 | .8 | 3,436 | ----- | --- | ---- | |
| | | | | | | | | 7-15-75 | 157.48 | 3,435 | 2,100 | 7.9 | 12.7 | | |
| 6 | ----- | WR-1 | 9 S. | 40 E. | 16 ABCA | 104.2 | An-Dz 1 coal | 7-24-75 | 83.95 | 0 | 3,374 | 4,800 | 7.0 | 11.4 | Well has 1½-inch diameter plastic casing. |
| 7 | 282-71 | WR-6 | 9 S. | 40 E. | 16 ABCD ₁ | 132.3 | An-Dz 1 coal | 7-24-75 | 82.41 | .6 | 3,376 | 4,600 | 7.1 | 13.0 | |
| | | | | | | | | 7-22-75 | 91.96 | .3 | 3,406 | 1,675 | 7.8 | 12.5 | |
| 8 | 283-71 | WR-7 | 9 S. | 40 E. | 16 ABCD ₂ | 200.2 | Dz 2 coal | 7-22-75 | 55.36 | .7 | 3,443 | 1,600 | 7.8 | 11.4 | |
| 9 | 333-72 | WR-12 | 9 S. | 40 E. | 17 DACC ₁ | 231.4 | An-Dz 1 coal | 7-16-74 | 158.1 | .9 | 3,424 | 1,500 | 7.9 | 10.8 | |
| 10 | ----- | WR-4 | 9 S. | 40 E. | 17 DACC ₂ | 200.3 | An-Dz 1 coal | 10-16-74 | 159.4 | .9 | 3,422 | ----- | --- | ---- | |
| | | | | | | | | 7-15-75 | 160.17 | .9 | 3,422 | 1,500 | 7.8 | 10.8 | |
| 11 | ----- | WR-16 | 9 S. | 40 E. | 18 AABD | 237.0 | An-Dz 1-Dz 2 coal | 7-16-74 | 155.47 | .9 | 3,424 | 1,550 | 7.8 | 10.8 | Well has 1½-inch diameter plastic casing. |
| | | | | | | | | 10-16-74 | 156.45 | .9 | 3,423 | ----- | --- | ---- | |
| 12 | ----- | WR-15 | 9 S. | 40 E. | 19 BACA | 386.0 | An-Dz 1-Dz 2 coal | 7-15-75 | 157.91 | .9 | 3,422 | 1,525 | 7.8 | 10.8 | |
| | | | | | | | | 7-12-74 | 185.7 | .6 | 3,455 | 1,670 | 7.9 | 12.9 | |
| 13 | 329-72 | WR-8 | 9 S. | 40 E. | 21 ACCA ₁ | 166.0 | An-Dz 1 coal | 10-16-74 | 187.4 | .6 | 3,453 | ----- | --- | ---- | |
| | | | | | | | | 7-20-75 | 188.62 | .6 | 3,452 | 1,675 | 7.8 | 12.2 | |
| 14 | 330-72 | WR-9 | 9 S. | 40 E. | 21 ACCA ₂ | 246.0 | Dz 2 coal | 7-18-74 | 238.20 | 1.7 | 3,456 | 1,620 | 8.0 | 11.9 | |
| | | | | | | | | 10-16-74 | 238.64 | 1.7 | 3,456 | ----- | --- | ---- | |
| | | | | | | | | 5-19-75 | 239.88 | 1.7 | 3,455 | ----- | --- | ---- | |
| | | | | | | | | 7-20-75 | 240.68 | 1.7 | 3,454 | 1,650 | 6.9 | 12.7 | |
| | | | | | | | | 7-17-74 | 109.05 | 1.0 | 3,425 | 2,725 | 7.9 | 10.0 | |
| | | | | | | | | 10-16-74 | 112.09 | 1.0 | 3,422 | ----- | --- | ---- | |
| | | | | | | | | 7-19-75 | 113.48 | 1.0 | 3,421 | 2,700 | 7.8 | 10.0 | |
| | | | | | | | | 7-17-74 | 78.56 | .9 | 3,455 | 930 | 7.8 | 11.1 | |
| | | | | | | | | 10-16-74 | 79.36 | .9 | 3,454 | ----- | --- | ---- | |
| | | | | | | | | 7-19-75 | 81.73 | .9 | 3,452 | 950 | 7.1 | 11.4 | |

Table D-2.--Observation wells in the West Decker area, Big Horn County, Montana--Continued

| Number | Decker Coal Co. number | Montana Bureau of Mines number | Location | | | Altitude of land surface (feet) | Depth of well (feet) | Aquifer | Date of measurement | Water level | | | Water quality | | | Remarks |
|--------|------------------------|--------------------------------|-----------|-------|---------|---------------------------------|----------------------|-----------------------|--------------------------------|----------------------------|-------------------|-------------------------|--------------------------------------|-------------------|---------------------|-------------------------------------------|
| | | | Town-ship | Range | Section | | | | | Depth (feet) | MP (feet) | Altitude (feet) | Specific conductance (micromhos/cm) | pH | Temperature (°C) | |
| 15 | ----- | WR-5 | 9 S. | 40 E. | 21 BCDA | 3,575 | 182.0 | An-Dz 1 overburden(?) | 7-16-74 10-16-74 7-15-75 | 111.00 111.56 111.98 | .9 .9 .9 | 3,465 3,464 3,464 | 4,300 ----- 4,100 | 7.7 --- 7.4 | 10.8 --- 11.0 | Well has 1½-inch diameter plastic casing. |
| 16 | 332-72 | WR-11 | 9 S. | 40 E. | 21 BCDB | 3,575 | 212.0 | An-Dz 1 coal | 7-16-74 10-16-74 7-15-75 | 146.36 147.49 148.66 | .7 | 3,429 3,428 3,427 | 3,000 | 7.85 | 11.4 | |
| 17 | 331-72 | WR-10 | 9 S. | 40 E. | 21 CADA | 3,537 | 194.2 | An-Dz 1 coal | 7-16-74 10-16-74 7-19-75 | 111.02 112.06 113.64 | .8 | 3,427 3,426 3,424 | 2,750 2,750 | 7.7 7.8 | 9.7 11.0 | |
| 18 | ----- | WR-17 | 9 S. | 40 E. | 29 BBDB | 3,578 | 295.0 | An-Dz 1-Dz 2 coal | 7-18-74 10-16-74 7-24-75 | 114.49 113.87 117.10 | 2.1 2.1 2.1 | 3,466 3,466 3,463 | 1,825 ----- 1,850 | 7.9 --- 7.8 | 10.3 --- 11.3 | |

Table D-3.--Observation wells in the East Decker area, Big Horn County, Montana

Location: See fig. D-1 for description of well-numbering system. Location taken from Decker Coal Co. maps, scale 1:6,000.
 Altitude of land surface: Distance above mean sea level determined by level surveys made by Decker Coal Co. Accurate to 1 ft.
 Depth of well: Measured below top of casing.

Aquifer: An, Anderson; Dz 1, Dietz 1; Dz 2, Dietz 2. Identification of aquifer made by Montana Bureau of Mines and Geology.
 Water level: MP, height of measuring point above land surface. Altitude of water level is distance above mean sea level.
 Water quality: Field measurements on water sample bailed from well.

| Number | Decker Coal Co. number | Montana Bureau of Mines number | Location | | | Altitude of land surface (feet) | Depth of well (feet) | Aquifer | Date of measurement | Water level | | | Water quality | | | Remarks |
|--------|------------------------|--------------------------------|-----------|-------|----------------------|---------------------------------|----------------------|---------------|---------------------|----------------|------------|-----------------|--------------------------------------|------------|------------------|------------------------------------------------------------------------------------------------|
| | | | Town-ship | Range | Section | | | | | Depth (feet) | MP (feet) | Altitude (feet) | Specific conductance (micromhos/cm) | pH | Temperature (°C) | |
| 1 | 1242-74 | WRE-1 | 9 S. | 40 E. | 1 DCBA ₁ | 3,457 | 73.5 | Alluvium | 7-17-75 | 34.22 | 1.1 | 3,424 | 3,850 | 7.5 | 10.1 | Water polluted. |
| 2 | 1241-74 | WRE-2 | 9 S. | 40 E. | 1 DCBA ₂ | 3,457 | 74.0 | Alluvium | 7-17-75 | 35.20 | 2.1 | 3,424 | 3,800 | 7.5 | 10.1 | |
| 3 | 1076-74 | WRE-3 | 9 S. | 40 E. | 11 DCAD ₁ | 3,451 | 150.6 | Dz 2 coal | 7-21-75 | 29.37 | 0 | 3,422 | 2,750 | 7.9 | 10.8 | Dissolved gas in water. |
| 4 | 1077-74 | WRE-4 | 9 S. | 40 E. | 11 DCAD ₂ | 3,452 | 67.5 | Dz 1 coal | 7-17-75 | 31.53 | .2 | 3,420 | 2,000 | 7.4 | 10.7 | |
| 5 | 1167-74 | WRE-6 | 9 S. | 40 E. | 12 ABAB | 3,478 | 49.1 | Dz 1 clinker | 7-17-75 | 43.82 | 0 | 3,435 | 2,450 | 7.7 | 9.0 | |
| 6 | 1168-74 | WRE-5 | 9 S. | 40 E. | 12 ABBA | 3,478 | 131.0 | Dz 2 coal | 7-17-75 | 54.97 | .5 | 3,424 | 3,700 | 7.4 | 8.5 | |
| 7 | 1201-74 | WRE-7 | 9 S. | 40 E. | 12 BCAB ₁ | 3,445 | 46.3 | Dz 1 coal | 7-17-75 | 25.31 | 1.6 | 3,421 | 2,225 | 7.0 | 11.0 | Water yellow--from dye? |
| 8 | ----- | | 9 S. | 40 E. | 12 BCAB ₂ | 3,445 | 51.3 | Dz 1 coal | 7-17-75 8-26-75 | 25.39 ----- | 1.7 1.7 | 3,421 ----- | 2,600 2,250 | 7.4 --- | 11.2 ---- | Water clear |
| | | | | | | | | | | | | | | | | Water yellow--from dye? |
| 9 | 1202-74 | WRE-8 | 9 S. | 40 E. | 12 BCAB | 3,445 | 45.0 | Dz 1 coal | 7-17-75 | 25.17 | 1.3 | 3,421 | 1,810 | 6.9 | 11.1 | Water yellow--from dye? |
| 10 | 1080-74 | WRE-9 | 9 S. | 40 E. | 13 DCCB ₁ | 3,511 | 229.5 | Dz 2 coal | 6-23-75 | 81.28 | 1.95 | 3,431 | 2,275 | 8.3 | 11.8 | Paint odor of H ₂ S. |
| 11 | 1081-74 | WRE-10 | 9 S. | 40 E. | 13 DCCB ₂ | 3,518 | 178.3 | Dz 1 coal | 6-23-75 | 97.97 | 2.2 | 3,423 | 980 to 2,450 | 7.9 | 10.6 | EC in upper part of hole - 980 micromhos/cm. EC in lower part of hole - 2,450 micromhos/cm. |
| 12 | 1082-74 | WRE-11 | 9 S. | 40 E. | 13 DCCD | 3,509 | 124.2 | An coal | 6-23-75 | 71.54 | 1.4 | 3,439 | 2,350 | 7.8 | 10.6 | |
| 13 | 1144-74 | WRE-12 | 9 S. | 40 E. | 23 BCCD ₁ | 3,462 | 172.7 | An coal | 7-20-75 | 44.84 | 0 | 3,417 | 2,400 | 7.8 | 11.2 | |
| 14 | 1180-74 | WRE-13 | 9 S. | 40 E. | 23 BCCD ₂ | 3,461 | 203.6 | Dz 1 coal | 7-17-75 | 46.05 | .4 | 3,415 | 2,500 | 8.0 | 10.9 | |
| 15 | 1179-74 | WRE-14 | 9 S. | 40 E. | 23 CBBA | 3,463 | 290.0 | Dz 2 coal | 7-16-75 | 12.89 | .6 | 3,451 | 2,500 | 8.0 | 11.2 | |
| 16 | 1085-74 | WRE-16 | 9 S. | 40 E. | 24 AACD | 3,550 | 434.6 | An coal | 6-24-75 | 56.99 | 2.0 | 3,496 | 2,800 | 8.0 | 10.5 | Paint odor of H ₂ S. Strong odor of H ₂ S. |
| 17 | 1177-74 | WRE-19 | 9 S. | 40 E. | 24 ABAD ₁ | 3,520 | 135.3 | An coal | 6-24-75 | 83.85 | 2.25 | 3,439 | 2,625 | 7.8 | 10.3 | |
| 18 | 1087-74 | WRE-20 | 9 S. | 40 E. | 24 ABAD ₂ | 3,519 | 120.1 | An coal | 6-23-75 | 82.58 | 2.0 | 3,439 | 3,000 | 7.6 | 10.5 | |
| 19 | 1086-74 | WRE-21 | 9 S. | 40 E. | 24 ABAD ₃ | 3,529 | 128.7 | An coal | 6-24-75 | 92.38 | 1.6 | 3,439 | 1,975 | 10.7 | 10.4 | |
| 20 | 1084-74 | WRE-15 | 9 S. | 40 E. | 24 ADAB ₁ | 3,557 | 344.8 | Smith-An-Dz 1 | 6-23-75 | 60.75 | 2.0 | 3,498 | 2,800 | 8.0 | 10.5 | |
| 21 | 1083-74 | WRE-17 | 9 S. | 40 E. | 24 ADAB ₂ | 3,562 | 246.9 | Smith coal | 6-23-75 | 62.09 | 1.7 | 3,501 | 2,750 | 8.0 | 10.5 | |
| 22 | 1078-74 | WRE-18 | 9 S. | 40 E. | 24 ADAB ₃ | 3,573 | 425.0 | An coal | 6-23-75 | 78.08 | 1.75 | 3,497 | 3,000 | 7.8 | 11.0 | |

Table D-3.--Observation wells in the East Decker area, Big Horn County, Montana--Continued

| Number | Decker Coal Co. number | Montana Bureau of Mines number | Location | | | Altitude of land surface (feet) | Depth of well (feet) | Aquifer | Date of measurement | Water level | | | Water quality | | | Remarks |
|--------|------------------------|--------------------------------|----------|-------|---------------------|---------------------------------|----------------------|------------|---------------------|----------------|------------|-----------------|-------------------------------------|------------|------------------|------------------------------------|
| | | | Township | Range | Section | | | | | Depth (feet) | MP (feet) | Altitude (feet) | Specific conductance (micromhos/cm) | pH | Temperature (°C) | |
| 23 | 1174-74 | WRE-23 | 9 S. | 41 E. | 5 DCBD ₁ | 3,557 | 235.8 | Dz 2 coal | 6-24-75 | 108.37 | 1.35 | 3,450 | 3,250 | 7.9 | 11.5 | |
| 24 | 1173-74 | WRE-24 | 9 S. | 41 E. | 5 DCBD ₈ | 3,552 | 147.7 | Dz 1 coal | 6-24-75 | 67.29 | 2.15 | 3,487 | 3,300 | 7.9 | 10.5 | |
| 25 | 1172-74 | WRE-25 | 9 S. | 41 E. | 5 DCBD ₃ | 3,549 | 115.1 | An coal | 6-24-75 | 61.90 | 1.75 | 3,489 | 3,550 | 7.8 | 10.7 | Moderate odor of H ₂ S. |
| 26 | 1176-74 | WRE-22 | 9 S. | 41 E. | 8 BBAA | 3,495 | 39.0 | An clinker | 6-24-75 | 25.08 | 2.0 | 3,472 | 4,600 | 8.0 | 10.0 | Moderate odor of H ₂ S. |
| 27 | 1178-74 | WRE-26 | 9 S. | 41 E. | 8 BEAD | 3,478 | 36.3 | Alluvium | 6-24-75 | 11.19 | 2.2 | 3,469 | 3,000 | 11.6 | 9.0 | Surface caving around casing. |
| 28 | 1170-74 | WRE-27 | 9 S. | 41 E. | 8 CABC ₁ | 3,524 | 74.3 | An coal | 7-17-75 | 44.16 | .1 | 3,480 | 2,750 | 7.4 | 10.7 | |
| 29 | 1171-74 | WRE-28 | 9 S. | 41 E. | 8 CABC ₂ | 3,525 | 151.7 | Dz 1 coal | 7-17-75 | 53.17 | .1 | 3,472 | 3,800 | 7.6 | 11.4 | Strong odor of H ₂ S. |
| 30 | 1169-74 | WRE-29 | 9 S. | 41 E. | 8 CBAD | 3,523 | 215.0 | Dz 2 coal | 7-17-75 | 76.60 | 0 | 3,447 | 2,800 | 7.8 | 10.8 | |
| 31 | EDWT-1 | ----- | 9 S. | 41 E. | 18 BDAA | 3,524 | 100.4 | An coal | 7-15-74 7-20-75 | 61.19 59.55 | 1.2 1.2 | 3,464 3,466 | 2,000 ----- | 7.2 --- | 10.7 ---- | |

Table D-4.--Observation wells in the North Extension area, Big Horn County, Montana

Location: See fig. D-1 for description of well-numbering system. Location taken from
 Decker Coal Co. maps, scale 1:6,000.
 Altitude of land surface: Distance above mean sea level determined by level surveys made
 by Decker Coal Co. Accurate to 1 ft.
 Depth of well: Measured below top of casing.

Aquifer: An-Dz 1 coal, Anderson-Dietz 1 coal combined; An-Dz 1 clinker, clinker formed
 by burning of the Anderson-Dietz 1 coal combined; Dz 2 coal, Dietz 2 coal, Can coal,
 Canyon coal. Identification of aquifer made by Montana Bureau of Mines and Geology.
 Water level: MP, height of measuring point above land surface. Altitude of water level
 is distance above mean sea level.
 Water quality: Field measurements on water sample bailed from well.

| Number | Decker Coal Co. number | Montana Bureau of Mines number | Location | | | Altitude of land surface (feet) | Depth of well (feet) | Aquifer | Date of measurement | Water level | | | | Water quality | | | Remarks |
|--------|------------------------|--------------------------------|----------|-------|----------------------|---------------------------------|----------------------|-----------------------------|--------------------------------|-------------------------|----------------|-------------------------|--------------------------------------|-------------------|----------------------|----------------------------------------------------------------|---------|
| | | | Township | Range | Section | | | | | Depth (feet) | MP (feet) | Altitude (feet) | Specific conductance (micromhos/cm) | pH | Temperature (°C) | | |
| 1 | 1092-74 | WRN-2 | 8 S. | 40 E. | 33 AAC | 3,493 | 89.5 | Dz 2 coal | 7-18-75 | 54.49 | 0.5 | 3,439 | 1,475 | 7.9 | 10.1 | Water muddy and polluted | |
| 2 | 1093-74 | WRN-3 | 8 S. | 40 E. | 33 AACD | 3,491 | 58.9 | An-Dz 1 clinker | 7-18-75 | 54.09 | .5 | 3,438 | 2,200 | 7.7 | 10.0 | | |
| 3 | 1099-74 | WRN-4 | 8 S. | 40 E. | 33 CABE | 3,492 | 39.5 | An-Dz 1 coal | 7-19-75 | 13.91 | 2.3 | 3,481 | 1,700 | 7.0 | 16.1 | | |
| 4 | 1096-74 | WRN-5 | 8 S. | 40 E. | 33 CADA ₁ | 3,475 | 83.4 | Dz 2 coal | 7-19-75 | 15.88 | 0 | 3,459 | 1,725 | 7.2 | 10.0 | | |
| 5 | 1097-74 | WRN-6 | 8 S. | 40 E. | 33 CADA ₂ | 3,476 | 45.3 | An-Dz 1 coal | 7-19-75 | 10.47 | 0 | 3,466 | 1,675 | 7.0 | 9.3 | | |
| 6 | 1098-74 | WRN-7 | 8 S. | 40 E. | 33 CADB | 3,482 | 46.7 | An-Dz 1 coal | 7-19-75 | 10.36 | 0 | 3,472 | 1,675 | 6.9 | 9.8 | | |
| 7 | 1094-74 | WRN-9 | 8 S. | 40 E. | 34 DBDB ₁ | 3,424 | 186.6 | Can coal | 7-18-75 | 3.05 | 2.1 | 3,423 | 1,650 | 8.0 | 11.7 | | |
| 8 | 1095-74 | WRN-8 | 8 S. | 40 E. | 34 DBDB ₂ | 3,424 | 50.3 | Dz 2 coal | 7-18-75 | 5.54 | 1.5 | 3,420 | 410 | 7.2 | 10.5 | | |
| 9 | 1090-74 | WRN-10 | 9 S. | 40 E. | 3 DABE ₁ | 3,433 | 77.6 | Dz 2 coal | 7-19-75 | 10.23 | 0 | 3,423 | 750 | 7.3 | 10.6 | | |
| 10 | 1091-74 | WRN-11 | 9 S. | 40 E. | 3 DABB ₂ | 3,437 | 48.2 | An-Dz 1 coal and clinker | 7-19-75 | 15.79 | 0 | 3,421 | 775 | 7.7 | 13.8 | Casing loose in upper part of hole. | |
| 11 | 1221-74 | WRN-12 | 9 S. | 40 E. | 4 BCCA | 3,525 | 79.1 | An-Dz 1 coal and clinker | 7-19-75 | 73.66 | 2.4 | 3,454 | 1,725 | 7.4 | 10.6 | | |
| 12 | 1148-74 | WRN-13 | 9 S. | 40 E. | 4 BDCB | 3,514 | 123.1 | Dz 2 coal | 7-19-75 | 67.94 | 1.9 | 3,448 | 1,850 | 7.8 | 10.9 | | |
| 13 | 1149-74 | WRN-14 | 9 S. | 40 E. | 4 BDCC | 3,514 | 76.9 | An-Dz 1 coal | 7-19-75 | 68.31 | 2.5 | 3,448 | 1,650 | 7.0 | 11.0 | Dissolved gas in water. | |
| 14 | 1278-75 | ----- | 9 S. | 40 E. | 4 CBAD | 3,542 | 242.0 | An-Dz 1, Dz 2, and Can coal | 7-19-75 | 95.34 | 2.0 | 3,449 | 2,775 | 7.8 | 11.5 | | |
| 15 | 1274-75 | ----- | 9 S. | 40 E. | 5 ACBB | 3,563 | 174.4 | Dz 2 coal | 7-19-75 | 63.48 | 1.9 | 3,502 | 1,575 | 8.2 | 11.0 | | |
| 16 | 1019-74 | ----- | 9 S. | 40 E. | 9 AADD ₁ | 3,500 | 130.0 | Dz 2 coal | 7-17-74 10-16-74 7-18-75 | 72.64 71.87 75.17 | .7 .7 .7 | 3,428 3,429 3,426 | 1,640 ----- ----- | 7.7 --- --- | 10.5 ---- ---- | Water muddy Considerable gas bubbling upward through water. | |
| 17 | 1146-74 | WRN-15 | 9 S. | 40 E. | 9 AADD ₂ | 3,500 | 134.9 | Dz 2 coal | 7-15-75 | 74.26 | .6 | 3,426 | 1,575 | 7.8 | 11.1 | | |
| 18 | 1147-74 | WRN-16 | 9 S. | 40 E. | 9 AADD ₃ | 3,499 | 85.1 | An-Dz 1 clinker | 7-18-75 | 78.93 | 0 | 3,420 | 3,550 | 8.1 | 10.1 | | |
| 19 | 1088-74 | WRN-17 | 9 S. | 40 E. | 11 CBCC ₁ | 3,424 | 102.7 | Dz 2 coal | 7-20-75 | 3.27 | .2 | 3,421 | 1,640 | 7.8 | 9.8 | | |
| 20 | 1089-74 | WRN-18 | 9 S. | 40 E. | 11 CBCC ₂ | 3,425 | 17.0 | Alluvium | 7-20-75 | 5.11 | 0 | 3,420 | 5,000 | 7.4 | 8.9 | | |

Table D-5.---Springs in the Decker area, Big Horn County, Montana

Location: See fig D-1 for description of well-numbering system.
 Location interpreted from Decker Coal Co. maps, scale 1:6000, where available; elsewhere, interpreted from U. S. Geol. Survey 7½-min. quad. topographic maps, scale 1:24,000.
 Altitude above mean sea level: Interpreted from Decker Coal Co. maps, contour interval of 5 ft., where available; else-

where interpreted from U.S. Geol. Survey topographic maps, contour interval of 20 feet. Generally accurate to 10 feet.
 Aquifer: An, Anderson coal; Dz 1, Dietz 1 coal
 Discharge: E, estimated; M, measured,
 Water quality: Field measurements.
 Remarks: Water used only by livestock and wildlife.

| Number | Location | | Owner | Altitude above mean sea level (feet) | Aquifer | Date of measurement | Discharge gal/min | Water quality | | | Remarks |
|--------|----------|---------------|------------------------|--------------------------------------|----------------------------|---------------------|-------------------|-------------------------------------|-----|------------|-----------------------------------------------------------------------------------------------------------------------------|
| | T. | R. Section | | | | | | Specific conductance (micromhos/cm) | pH | Temp. (°C) | |
| 1 | 8 S. | 39 E. 33 ADCC | Consolidation Coal Co. | 4120 | Alluvium & clinker | 10-12-73 | 1 E | 680 | 7.6 | 10.5 | Similar springs probably could be developed in the bottoms of adjacent stream valleys. |
| 2 | 8 S. | 40 E. 33 CBDB | Decker Coal Co. | 3490 | Alluvium & An-Dz 1 clinker | 9-27-75 | 35-50 E | 1750 | 7.7 | 8.5 | Water discharges over a broad seep area in the bottom of South Fork Spring Creek channel. |
| 3 | 8 S. | 40 E. 34 ACCA | Decker Coal Co. | 3425 | An-Dz 1 clinker | 7-17-74 | 3-5 E | 1000 | 8.3 | 18.5 | Seep area is partially flooded by the Tongue River Reservoir at high stage. |
| 4 | 8 S. | 40 E. 34 DAAA | Decker Coal Co. | 3405 | An-Dz 1 clinker | 9-25-75 | 100-150 E | 890 | 7.7 | 9.1 | Spring is generally below reservoir level and is seldom used. |
| 5 | 9 S. | 40 E. 3 DABB | Decker Coal Co. | 3425 | Alluvium & An-Dz 1 clinker | 9-27-75 | 15-25 E | 670 | 7.5 | 10.9 | Spring discharges in the bottom of Pearson Creek channel. Used mainly in winter when Tongue River Reservoir is frozen over. |
| 6 | 9 S. | 40 E. 11 BBBD | Decker Coal Co. | 3415 | An-Dz 1 clinker | 9-27-75 | 900-1,000 E | 690 | 7.7 | 9.2 | Spring is submerged by Tongue River Reservoir at high stage. Used mainly in the winter at low stage. |
| 7 | 9 S. | 41 E. 12 BDGD | H. A. Porter | 3685 | Alluvium | Feb. 74 | 5 M | 2600 | --- | ---- | Spring probably originates from seepage from stock pond upstream. |

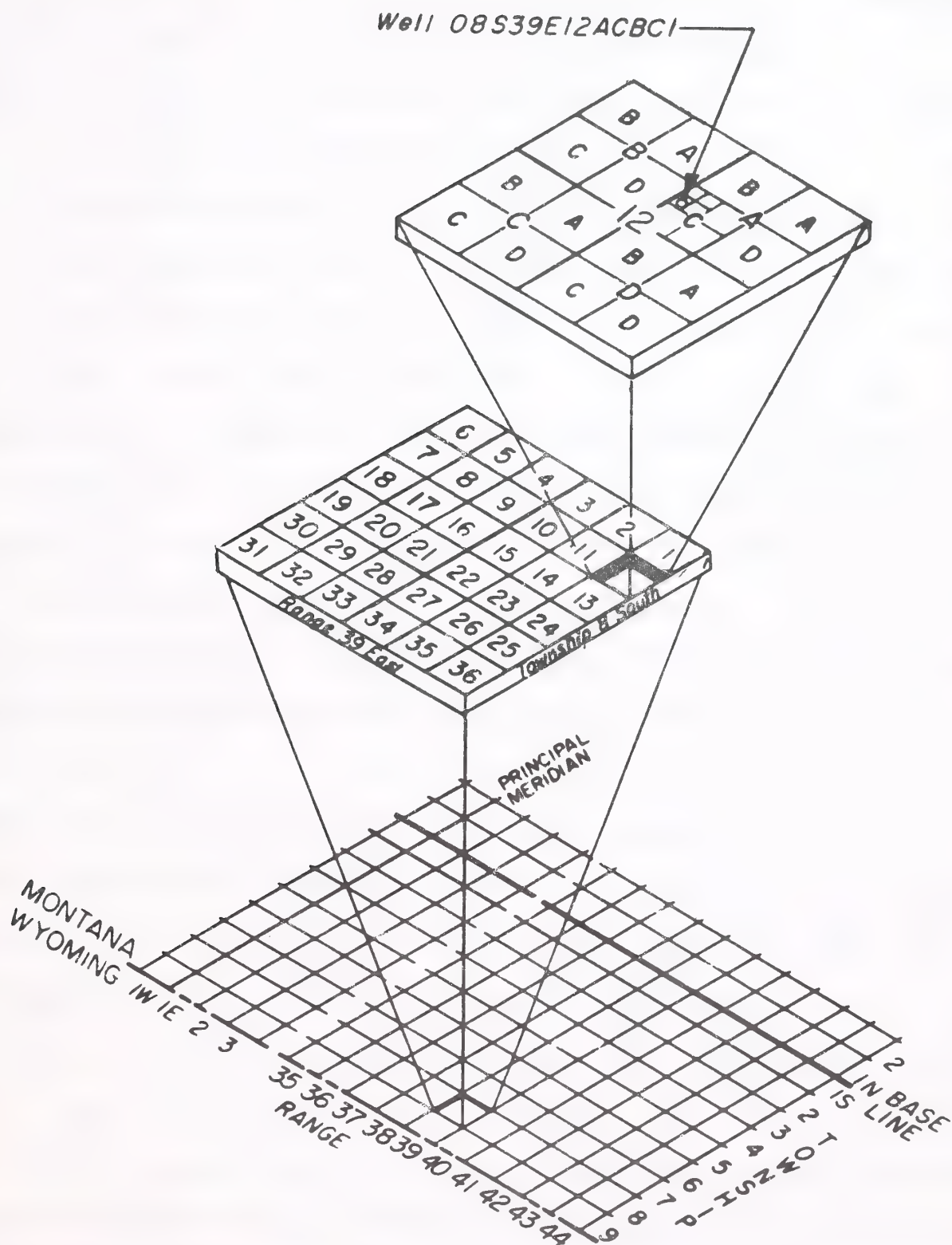


Figure D-1.--Well numbering system.

Method used to estimate flood magnitudes for streams in the Decker area

The following summarizes the methods and assumptions used to estimate the flood magnitudes (peak flows) to be expected for different recurrence intervals for ephemeral streams intercepted by the proposed Decker mines. The estimates are obtained by averaging the results derived from three different methods applicable to these kinds of streams; namely, equations from the Montana flood frequency analysis (Johnson and Omang, 1975), the channel-width method (Barnes, 1975) (Hedman, Moore, and Livingston, 1972) (Riggs, 1974), and the rational method. It is believed that the scattered water-control structures in the Decker area stream basins, such as stock ponds and water spreaders, would have only a minor effect on the 2- to 10-year recurrence-interval flows and no effect on larger storms. Of greater concern is the effect of the vegetative cover on infiltration and water storage, especially the effects attributable to the large spatial and temporal variations.

Montana flood frequency analysis.--The method makes use of equations obtained from a regression analysis of peak streamflows in Montana for thousands of gaging-station years in relation to drainage basin characteristics. The State-wide analysis shows that drainage area, main channel slope, and mean-annual precipitation are the most significant variables in quantifying peak flows. The following are equations for x-year recurrence-interval peak flows, Q_x in cubic feet per second, relating drainage area A , in square miles, main channel slope, S , between points that are 10 and 85 percent of the distance to the drainage divide, and mean annual rainfall, P , in inches. Also applied is an areal factor, F , to correct variance caused by regional differences and the resulting residuals from the regression analysis. For the Decker area, F is

estimated to be 1.0. For lack of more specific information, P = 13 inches is used for all streams in the Decker area.

$$\begin{aligned} Q_2 &= 2.18 A^{0.551} S^{-0.520} p^{1.58} F \\ Q_5 &= 31.7 A^{0.484} S^{-0.553} p^{1.08} F \\ Q_{10} &= 112 A^{0.455} S^{-0.576} p^{0.860} F \\ Q_{25} &= 388 A^{0.429} S^{-0.597} p^{0.640} F \\ Q_{50} &= 855 A^{0.412} S^{-0.622} p^{0.503} F \\ Q_{100} &= 1,745 A^{0.396} S^{-0.624} p^{0.378} F \end{aligned}$$

Pertinent drainage basin characteristics and the results from these equations are given in table D-6. The relationship between unit peak discharge (ft^3/s per mi^2 .) and recurrence interval is shown in figure D-2 for the different streams.

Existing channel width.--This method uses information obtained by measurement of channel cross sections at several locations. The number of sections measured and the average width, W, from bank to bank for the stream channels at several locations are given in table D-7. The drainage area is given for each location where cross sections were measured. The Q_{10} for each location is based on the relationship defined by Riggs and others for 20 Wyoming streams where

$$Q_{10} = 8.3 W^{1.49}$$

The relationship between drainage area and Q_{10} for the channel-width method (table D-7) is shown in figure D-3. This regression was then used

Table D-6.--Basin characteristics and peak-discharge rates determined by formulas from Montana Flood Frequency Analysis.

| Stream | Basin characteristics | | | | Peak discharge, cfs | | | | |
|--------------------|----------------------------|-----------------------------|----------------|------------------|---------------------|----------------|-----------------|-----------------|-----------------|
| | Area (mi ²) | Elevation change (ft) | Length (mi) | Slope (ft/mi) | Q ₂ | Q ₅ | Q ₁₀ | Q ₂₅ | Q ₅₀ |
| Deer Creek | 49 | 1,160 | 21 | 31 | 180 | 500 | 830 | 1,400 | 1,900 |
| Middle Creek | 4.5 | 950 | 4.4 | 103 | 26 | 81 | 140 | 240 | 340 |
| Coal Creek | 2.1 | 560 | 2.2 | 150 | 14 | 45 | 75 | 140 | 180 |
| Spring Creek | 36 | 1,450 | 14 | 79 | 92 | 250 | 420 | 680 | 930 |
| Pearson Creek | 7.5 | 620 | 5.6 | 98 | 35 | 110 | 180 | 310 | 430 |
| Pond Cr. Diversion | 2.8 | 600 | 2.8 | 142 | 18 | 53 | 86 | 160 | 210 |

Table D-7.--Computation of 10-year peak flow from channel width.

| Stream | Area (mi ²) | Number | Average width, W (ft) | Q ₁₀ (cfs) | Regression Q ₁₀ (cfs) | Area (mi ²) |
|---------------------|----------------------------|--------|-----------------------------|--------------------------|-------------------------------------|----------------------------|
| Deer Creek | 50 | 7 | 29 | 1,250 | 1,250 | 49 |
| Middle Creek | 6.4 | 7 | 14 | 430 | 460 | 4.5 |
| | 6.2 | 7 | 11 | 300 | | |
| | 5.8 | 5 | 13 | 380 | | |
| | 4.6 | 4 | 12 | 340 | | |
| Coal Creek | 2.8 | 4 | 12 | 340 | 350 | 2.1 |
| | 2.6 | 4 | 10 | 260 | | |
| Spring Creek | 21 | 6 | 23 | 880 | 1,100 | 36 |
| South Spring Creek | 14 | 10 | 21 | 760 | | |
| Pearson Creek | 5.7 | 8 | 15 | 475 | 580 | 7.5 |
| Pond Creek | 1.3 | 7 | 12 | 340 | 390 | 2.8 |
| N. Trib. Pond Creek | .4 | 3 | 8 | 185 | | |

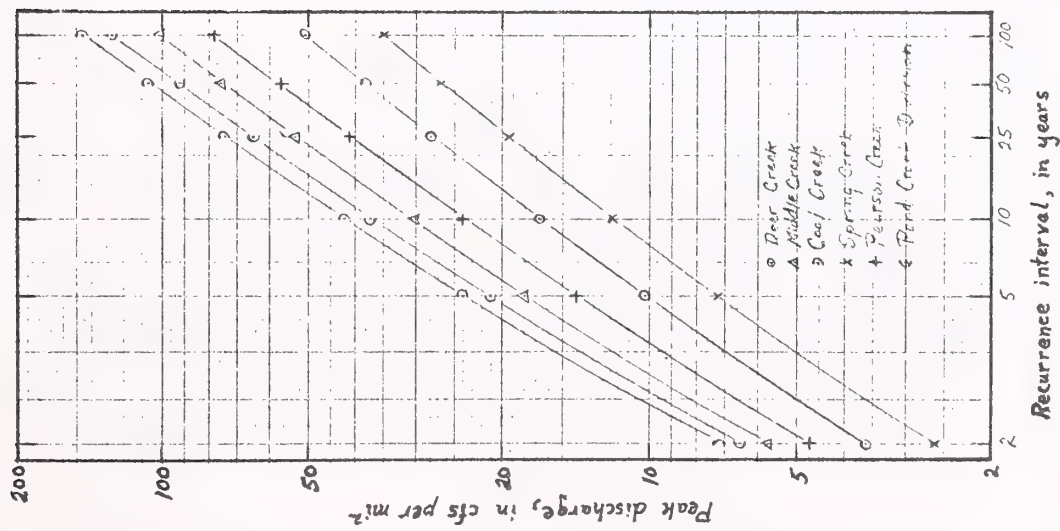


Figure D-2. Relationship of peak discharge to recurrence interval determined by the Montana flood frequency analysis for the Decker area streams.

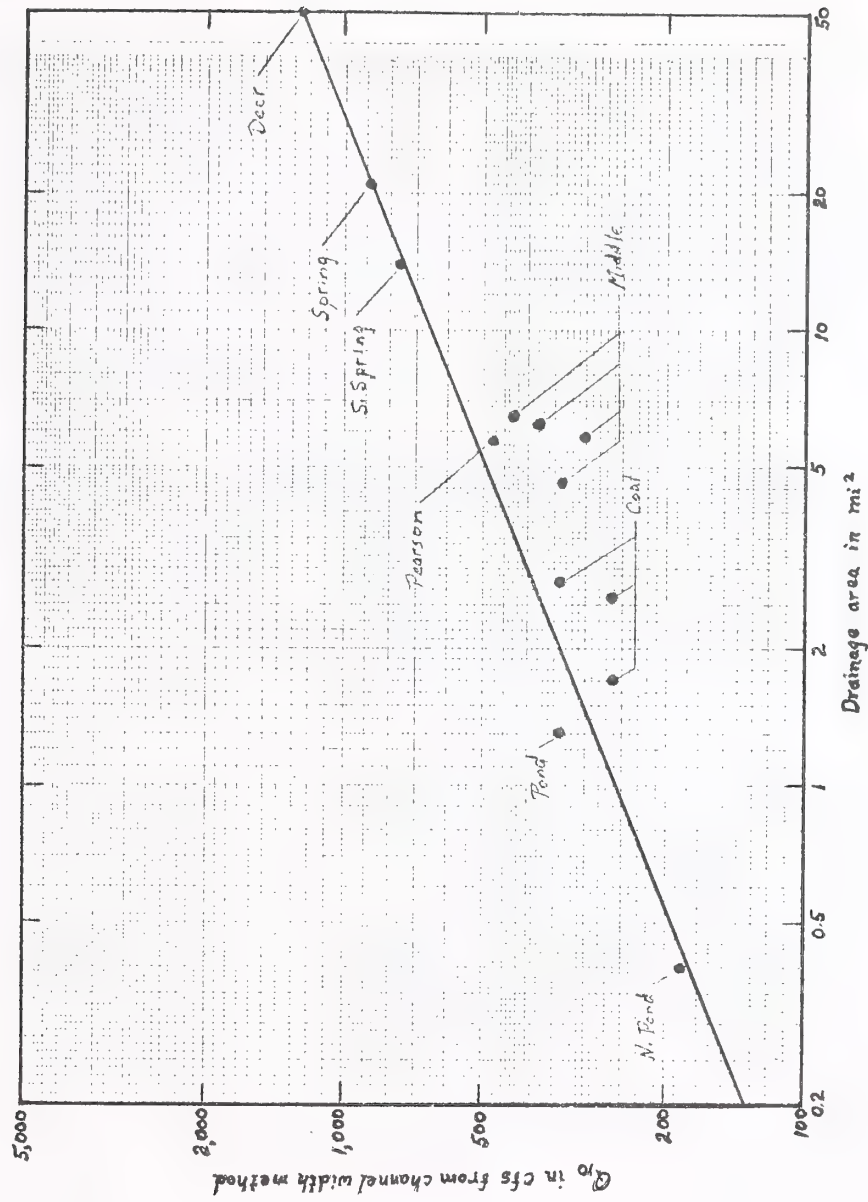


Figure D-3. Relationship of Q_{10} from channel width measurements to drainage area for Decker area streams.

to define Q_{10} for the drainage areas of interest (last two columns table D-7).

Rational method.--The rational method is the logical use of the expected rate of percipitation corrected for infiltration and other storage "losses". The formula is:

$$Q = CIA$$

where C is the fractional part of the precipitation expected to flow into and through the channel system, I is the rainfall intensity in inches per hour, and A is the drainage area in acres. The precipitation is the maximum amount expected for a given recurrence interval for a given duration. The duration used is that corresponding to the time of concentration of flow, T_c , from the drainage divide downstream to the point of measurement. For Decker area streams, T_c is based on an average flow velocity of 2.5 and 3.5 feet per second along the stream valley for Q_{10} and Q_{50} , respectively. The coefficient, c, is assumed to be 0.25 and 0.30 for Q_{10} and Q_{50} , respectively. Precipitation data are from table 4 "Magnitude and Frequency of Precipitation" in the section on climate.

Table D-8 gives the area of each stream basin in acres and Q_{10} and Q_{50} for the time of concentration, point precipitation, point intensity, area intensity, and the expected peak discharge. The 50-year peak discharge was computed to determine if its relation to the 10-year peak would be similar to that determined by the method using the Montana Flood Frequency analysis. The relative differences are similar.

The recommended estimate of the 10-year peak flow for the different streams is determined as the average computed from the 3 methods as shown by table D-9. The table lists peak flows for other recurrence intervals, Q_2 , Q_5 , Q_{25} , Q_{50} , and Q_{100} . These were determined on the basis of the average Q_{10} and the peak discharge-recurrence interval graphs defined by the "Montana Flood Frequency" equations (figure D-2).

Table D-8. Basin data and 10-year and 50-year peak discharges by the rational method.

| Stream | Area (acres) | For 10-year peak, Q_{10} | | | | | For 50-year peak, Q_{50} | | | | |
|--------------------|-----------------|----------------------------|-----------------|--------------------|-------------------|--------------------|----------------------------|-----------------|--------------------|-------------------|--------------------|
| | | Tc (hr) | Point P (in) | Point I (in/hr) | Area I (in/hr) | Discharge (cfs) | Tc (hr) | Point P (in) | Point I (in/hr) | Area I (in/hr) | Discharge (cfs) |
| Dear Creek | 31,400 | 8.0 | 1.60 | 0.20 | 0.19 | 1,500 | 6.0 | 2.20 | 0.37 | 0.34 | 3,200 |
| Middle Creek | 2,900 | 1.8 | 1.18 | .66 | .64 | 460 | 1.3 | 1.67 | 1.28 | 1.23 | 1,100 |
| Coal Creek | 1,300 | .9 | 1.05 | 1.17 | 1.13 | 370 | .6 | 1.35 | 2.25 | 2.14 | 830 |
| Spring Creek | 23,000 | 6.0 | 1.50 | .25 | .24 | 1,400 | 4.0 | 2.00 | .50 | .46 | 3,200 |
| Pearson Creek | 4,800 | 2.4 | 1.25 | .52 | .50 | 600 | 1.7 | 1.71 | 1.01 | .96 | 1,400 |
| Pond Cr. Diversion | 1,800 | 1.1 | 1.11 | 1.01 | .98 | 440 | .8 | 1.55 | 1.94 | 1.87 | 1,000 |

Table D-9. Recommended estimates of peak flows for streams at proposed Decker mines, Montana.

| Streams | Q_2 | Q_5 | Q_{10} | Q_{25} | Q_{50} | Q_{100} |
|----------------------|-------|-------|----------|----------|----------|-----------|
| Deer Creek | 270 | 750 | 1,200 | 2,000 | 2,700 | 3,600 |
| Middle Creek | 62 | 200 | 350 | 630 | 890 | 1,200 |
| Coal Creek | 50 | 150 | 260 | 440 | 630 | 840 |
| Spring Creek | 210 | 570 | 970 | 1,600 | 2,200 | 2,900 |
| Pearson Creek | 80 | 260 | 450 | 700 | 1,100 | 1,500 |
| Pond Creek Diversion | 57 | 180 | 300 | 530 | 750 | 1,000 |

Methods used to estimate erosion and sediment yield from watersheds in the Decker area

In the absence of adequate data, sediment yield and sediment concentration in streams in the Decker area could not be determined by using standard methods such as sediment-rating and flow-duration curves, reservoir sediment-deposition surveys, or from various empirical formula. Accordingly, estimates were made using the sediment-delivery ratio method, which makes use of a logical set of factors, namely precipitation energy, soil erodibility, surface slopes, and plant cover to arrive at gross erosion (U.S. Department of Agriculture, 1972 B). Because of the paucity of data for streams in the Decker area, the sediment-delivery ratio was determined by using the basin-relief ratio to adjust the nationwide sediment-delivery ratio curve (Roehl, 1962).

Roehl reports that the scatter found in the drainage area-delivery ratio relationship (fig. D-4) can be attributed largely to variations in relief ratio. The relief ratio-drainage area data from Roehl (1962) and for Decker area stream basins are plotted in figure D-5. This plot shows that the relief ratios for Decker area basins are higher than those used by Roehl in defining the nationwide curve. The arrows on figure D-5 show the method used to adjust for these differences. For example, the Deer Creek basin, which has a drainage area of 53 mi², has a relief ratio of 0.010. According to the Roehl curve, a basin having a relief of 0.010 should have a drainage area of only 15 mi². To use Roehl's nationwide sediment-delivery curve (fig. D-4), therefore, Decker area data must be adjusted accordingly. The adjusted delivery ratios listed in table D-10 are obtained from figure D-4 using the adjusted areas obtained from figure D-5.

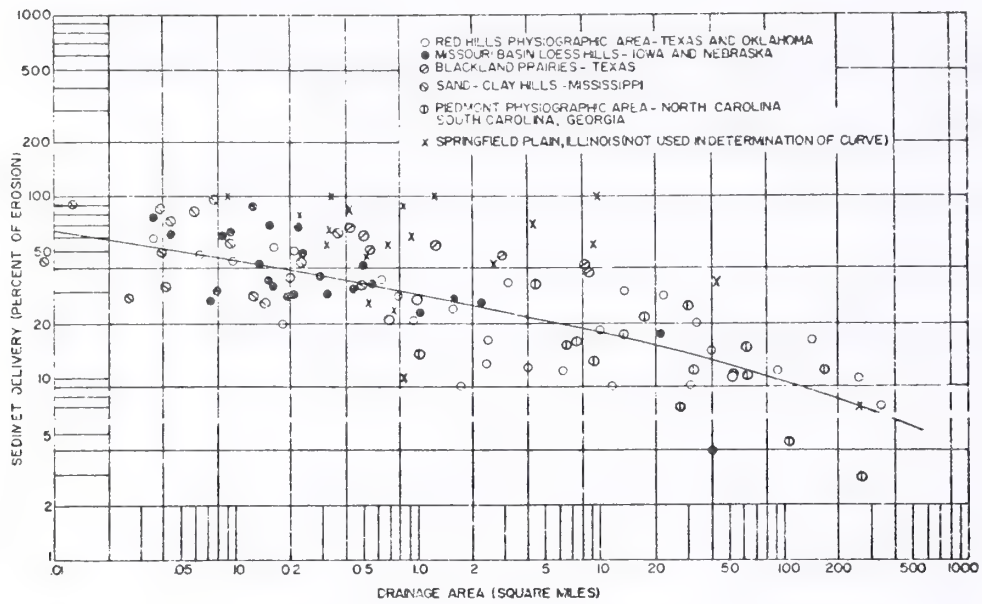


Figure D-4.--Effect of drainage basin size on sediment delivery (from Roehl, 1962)

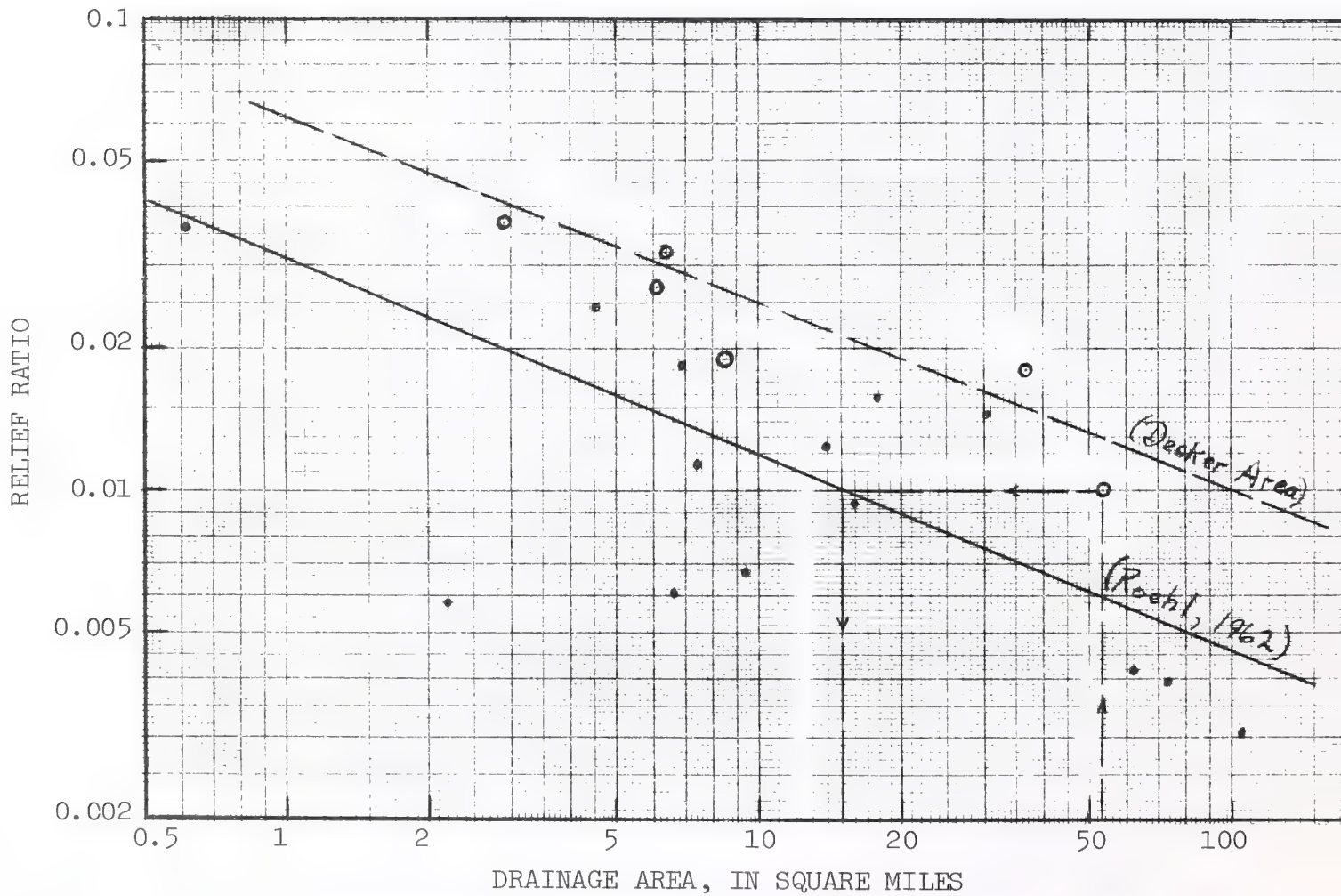


Figure D-5.--Relationship of relief ratio to drainage area--Roehl (1962) data and Decker area basins.

Gross erosion, E, in tons per acre was determined from the Universal Soil Loss Equation

$$E = RK(LS)C$$

where R is a precipitation factor, K is a soil-erodibility factor, (LS) is a slope factor, and C is a plant-cover factor.

As specific data for these factors are not available for individual watersheds in the Decker area, the computation of gross erosion in table D-11 applies an average value to all Decker area basins. These values were adjusted on the basis of slope gradient. Slope conditions are expected to affect gross erosion, and therefore, a distribution curve showing the average land-surface slope for Decker basins was developed (fig. D-6). This curve is based on measurements of the distance between contours at 577 locations spaced at intervals of 1,000 feet. These measurements were made in six representative areas of the Decker stream basins using the method described by Williams and Guy (1973).

Five slope categories were used as shown in the first column of table D-11. The relative percentage of the basin areas for each category is given in the second column. The precipitation factor (R) is expected to be 20 for the Decker area (Wayne Nipple, Conservationist, Soil Conservation Services, oral communication). The soil-erodibility factor (K) is expected to range from 0.24 to 0.40, depending on slope (steeper slopes have less organic matter and probably a lower percentage

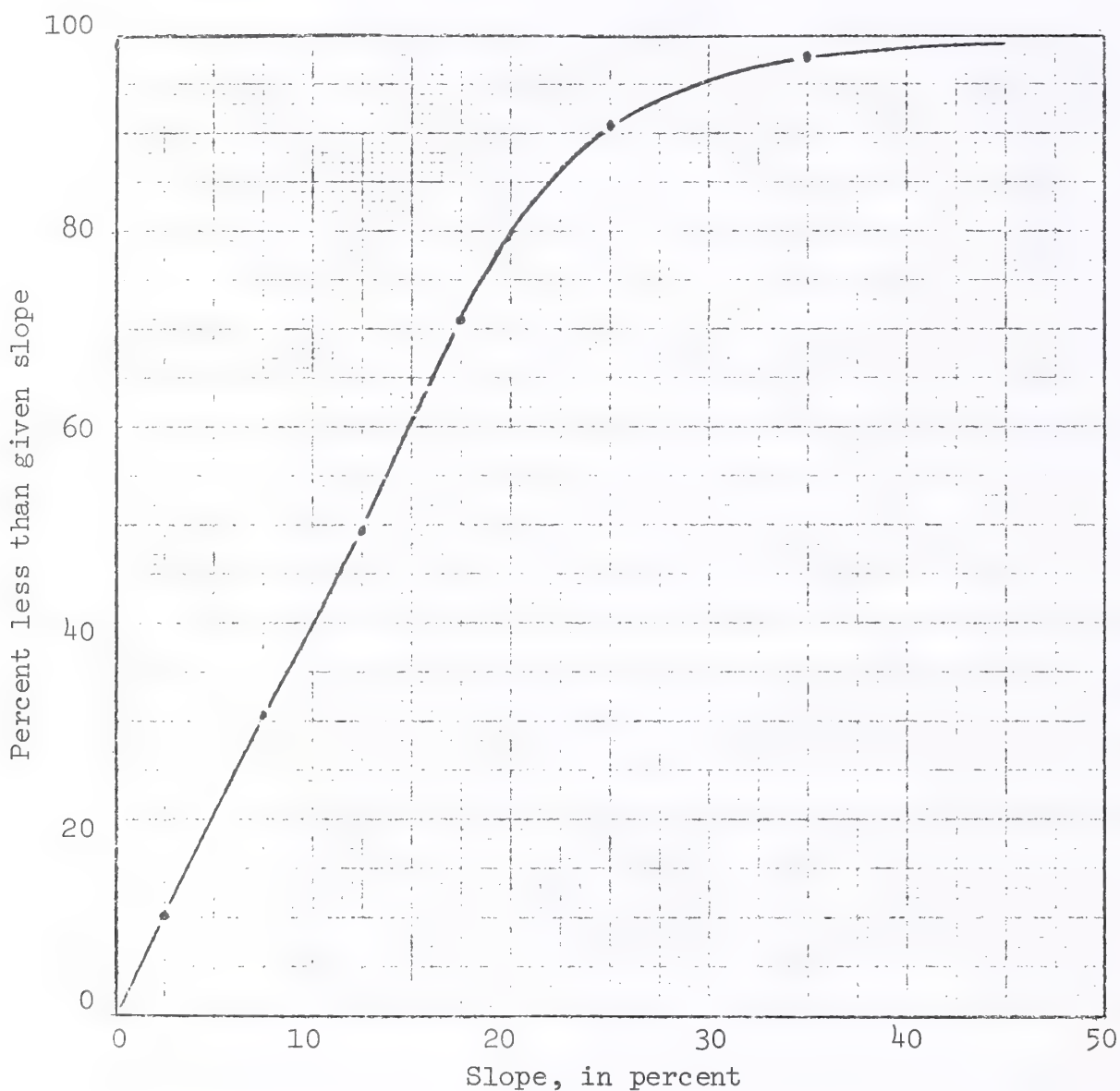


Figure D-6.--Distribution curve showing average land-surface slope of stream basins intercepted by the East Decker and North Extension mine areas. (Based on measurements of distance between contours at 577 locations using 1,000-foot grid points in six representative areas; Williams and Guy, 1973).

of particle binding clays). Slope-length (L) is expected to range from an average of about 400 feet for areas having slopes less than 10 percent to about 150 feet for areas having slopes greater than 40 percent gradient. The slope factor (LS) is expressed by the equation, $LS = (L/75)^{0.6} \times (S/9)^{1.4}$. The plant-cover factor (C) is expected to range from 0.10 to 0.25, depending on slope (steeper slopes have less cover because of less soil moisture and probably less soil fertility).

Computed gross erosion rates and weighted gross erosion rates are listed in table D-11 for each slope category. The average gross erosion rate for the Decker area stream basins is 3.94 tons per acre per year. The last column in table D-11 shows the percent of total gross erosion expected for each slope category.

Mean annual sediment yield for each stream listed in table D-12 is based on the average of 3.93 tons of gross erosion and the sediment delivery ratios computed in table D-10. Yield in acre-feet per square mile assumes a specific weight of sediment of 70 pounds per cubic foot. The yields indicated in table D-12 are similar to those found by Hadley and Schumm (1961) (fig. D-7) in the Cheyenne River basin in northeastern Wyoming under similar geologic, hydrologic and geomorphic conditions.

The computed sediment yield for each basin and the expected mean annual runoff were used to compute the discharge-weighted mean annual sediment concentration of basin streams listed in the last column of table D-12. On a regional basis Busby (1966) shows an expected long-term mean annual runoff of about 0.4 to 0.5 inch per year for the Decker area. Because of the effect of extensive permeable clinker deposits in the lower parts of their watersheds, the expected runoff from Middle Creek, Coal Creek and Pond Creek is 0.4 inch, Deer Creek is 0.3 inch, Spring Creek is 0.25 inch, and Pearson Creek is 0.2 inch.

Table D-10.—Computation of sediment delivery ratio

| Stream | Drainage area (mi ²) | Basin length (mi) | Elevation change (ft) | Relief ratio | Adjusted area (mi ²) | Adjusted delivery ratio |
|----------------------|----------------------------------------|-------------------------|-----------------------------|-----------------|----------------------------------------|-------------------------------|
| Deer Creek | 53.3 | 23 | 1,200 | 0.010 | 15 | 0.17 |
| Middle Creek | 6.3 | 6.4 | 1,070 | .032 | .9 | .29 |
| Coal Creek | 2.9 | 3.3 | 650 | .037 | .7 | .31 |
| Spring Creek | 36.9 | 16 | 1,530 | .018 | 3.7 | .22 |
| Pearson Creek | 8.5 | 7.2 | 720 | .019 | 3.2 | .23 |
| Pond Creek Diversion | 6.1 | 5.4 | 780 | .027 | 1.4 | .27 |

Table D-11.—Computation of gross erosion

| Slope category (%) | Relative area (%) | Rainfall factor (R) | Soil factor (K) | Slope length (L) | Slope factor (LS) | Cover factor (C) | Gross erosion T/ac/yr | Weighted gross erosion (T/ac/yr) | Percent total |
|--------------------------|-------------------------|---------------------------|-----------------------|------------------------|-------------------------|------------------------|-----------------------------|-------------------------------------------|------------------|
| <10 | 40 | 20 | 0.25 | 400 | 1.2 | 0.10 | 0.60 | 0.24 | 6.1 |
| 10-20 | 40 | 20 | .30 | 300 | 4.7 | .13 | 3.67 | 1.47 | 37.4 |
| 20-30 | 15 | 20 | .33 | 250 | 7.7 | .16 | 8.13 | 1.22 | 31.0 |
| 30-40 | 2.5 | 20 | .36 | 200 | 11 | .20 | 15.8 | .55 | 14.0 |
| >40 | 1.5 | 20 | .40 | 150 | 15 | .25 | 30.0 | .45 | 11.5 |
| | | | | | | | | 3.93 | 100.0 |

Table D-12.—Computation of mean annual sediment yield and streamflow concentration

| Stream | Area (mi ²) | Delivery (ratio) | Yield | | | Concentration** (mg/l) |
|----------------------|----------------------------|---------------------|----------------------|---------------------------|--------|---------------------------|
| | | | (T/mi ²) | (Ac-ft/mi ² *) | (Tons) | |
| Deer Creek | 53 | 0.17 | 430 | 0.28 | 23,000 | 20,000 |
| Middle Creek | 6.3 | .29 | 730 | .48 | 4,600 | 25,000 |
| Coal Creek | 2.9 | .31 | 780 | .51 | 2,300 | 27,000 |
| Spring Creek | 37 | .22 | 550 | .36 | 20,000 | 30,000 |
| Pearson Creek | 8.5 | .23 | 580 | .38 | 4,900 | 40,000 |
| Pond Creek Diversion | 6.1 | .27 | 680 | .45 | 4,100 | 23,000 |

*Sediment weight = 70 pounds/ft³

**Discharge weighted assuming 0.3 inch of runoff per year for Deer Creek, 0.4 inch for Middle, Coal and Pond Creeks, 0.25 inch for Spring Creek, and 0.2 inch for Pearson Creek.

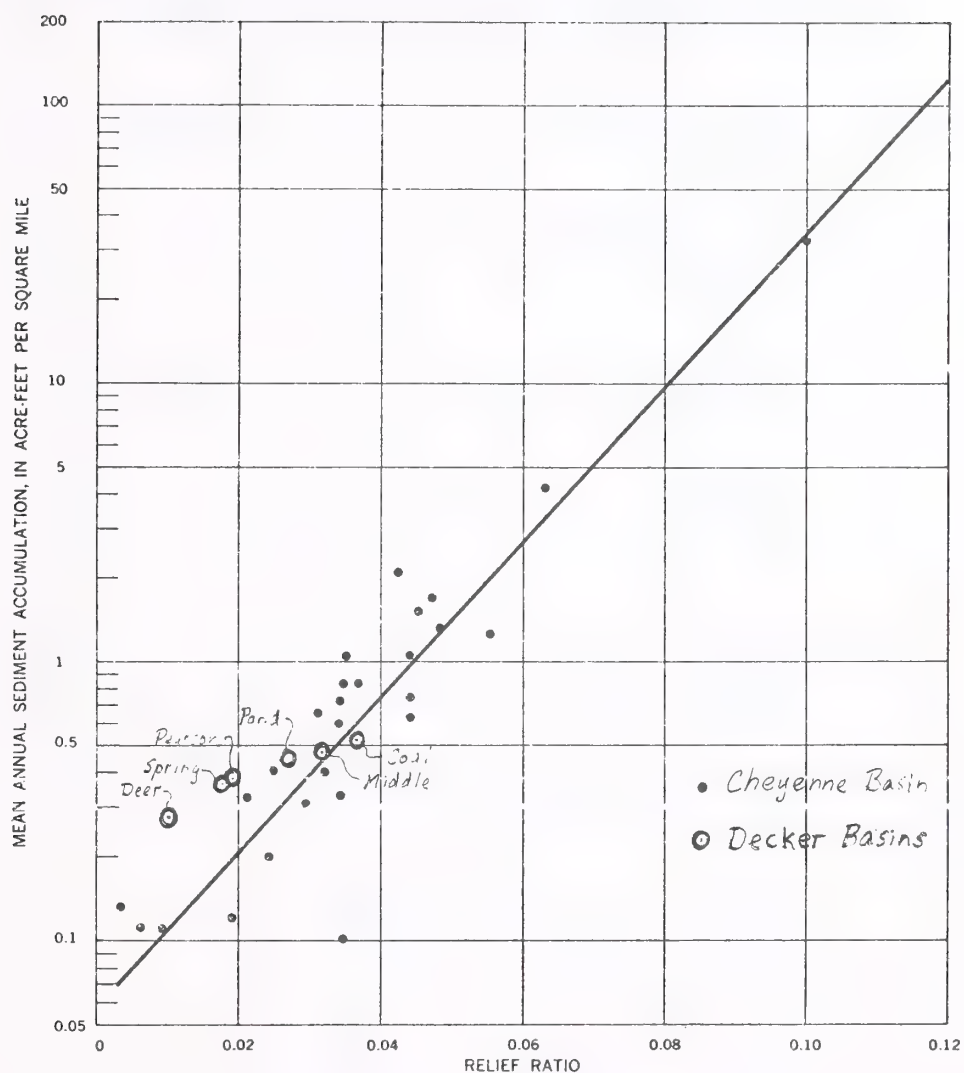


Figure D-7.--Relation between mean annual sediment accumulation and relief ratio for basins on Fort Union Formation (from Hadley and Schumm, 1961).

Table D-13.--Tongue River Reservoir, active storage in acre-feet
 (Data from records of the Montana Department of Natural
Resources and Conservation)

| Year | Minimum | Average | Maximum |
|------|---------|---------|---------|
| 1956 | 10,010 | 28,610 | 46,040 |
| 1957 | 1,010 | 24,130 | 48,130 |
| 1958 | 10,010 | 24,350 | 38,540 |
| 1959 | 15,590 | 37,210 | 73,530 |
| 1960 | 140 | 17,790 | 31,010 |
| 1961 | 10,090 | 37,170 | 59,990 |
| 1962 | 26,250 | 43,790 | 54,020 |
| 1963 | 31,870 | 37,330 | 43,450 |
| 1964 | 24,480 | 34,760 | 67,440 |
| 1965 | 22,600 | 38,860 | 63,300 |
| 1966 | 10,240 | 34,710 | 60,420 |
| 1967 | 22,460 | 37,620 | 64,290 |
| 1968 | 27,060 | 41,790 | 61,700 |
| 1969 | 20,500 | 41,420 | 63,300 |
| 1970 | 25,120 | 34,560 | 55,500 |
| 1971 | 23,350 | 35,120 | 52,320 |
| 1972 | 25,810 | 40,570 | 57,310 |
| 1973 | 26,890 | 39,200 | 61,700 |
| 1974 | 22,600 | 38,450 | 60,100 |

Table D-14.--Monthly and annual runoff in acre-feet of the Tongue River at State line near Decker, Montana
(Data from records of the U.S. Geological Survey, Water Resources Division)

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Annual |
|------|--------|--------|--------|--------|--------|--------|--------|---------|---------|--------|--------|--------|---------|
| 1961 | 7,160 | 8,910 | 8,930 | 8,170 | 8,720 | 7,960 | 7,350 | 30,750 | 35,370 | 5,380 | 1,010 | 5,850 | 135,600 |
| 1962 | 16,590 | 13,260 | 11,730 | 11,700 | 16,560 | 16,190 | 31,210 | 62,060 | 98,260 | 28,280 | 11,480 | 14,350 | 331,700 |
| 1963 | 15,520 | 12,390 | 8,640 | 10,490 | 18,000 | 12,540 | 21,800 | 99,640 | 171,700 | 22,230 | 5,140 | 6,870 | 405,000 |
| 1964 | 7,990 | 11,620 | 9,220 | 9,420 | 9,010 | 11,120 | 20,290 | 79,360 | 167,600 | 50,070 | 9,340 | 13,570 | 398,600 |
| 1965 | 13,960 | 13,390 | 13,980 | 14,120 | 15,320 | 22,600 | 33,060 | 67,600 | 130,300 | 35,050 | 11,830 | 19,170 | 390,400 |
| 1966 | 18,790 | 13,140 | 9,270 | 6,640 | 8,680 | 14,880 | 15,770 | 46,880 | 20,350 | 5,550 | 3,440 | 4,420 | 167,800 |
| 1967 | 10,720 | 10,820 | 8,940 | 10,360 | 10,980 | 14,120 | 15,340 | 72,800 | 178,900 | 52,880 | 11,460 | 16,300 | 413,600 |
| 1968 | 18,160 | 15,550 | 11,840 | 15,590 | 23,110 | 24,020 | 16,820 | 54,370 | 188,400 | 40,060 | 29,230 | 36,580 | 473,700 |
| 1969 | 24,750 | 18,850 | 15,350 | 12,730 | 9,930 | 42,890 | 34,290 | 78,400 | 60,900 | 38,390 | 6,790 | 6,080 | 349,400 |
| 1970 | 15,190 | 15,360 | 14,420 | 10,820 | 13,869 | 23,720 | 31,430 | 120,800 | 174,400 | 36,860 | 9,900 | 14,200 | 481,000 |
| 1971 | 16,910 | 15,220 | 14,870 | 15,060 | 37,320 | 28,650 | 34,620 | 74,070 | 116,000 | 20,900 | 6,200 | 10,810 | 390,600 |
| 1972 | 19,060 | 17,300 | 12,990 | 12,890 | 16,090 | 52,570 | 22,710 | 64,440 | 80,090 | 24,190 | 15,310 | 16,010 | 353,600 |
| 1973 | 19,650 | 15,850 | 12,250 | 11,980 | 12,300 | 15,350 | 25,630 | 104,500 | 118,500 | 29,150 | 9,980 | 27,060 | 402,200 |
| 1974 | 23,540 | 19,290 | 14,520 | 20,320 | 14,920 | 14,710 | 27,410 | 68,150 | 92,240 | 23,130 | 11,530 | 13,390 | 343,100 |

**Table D-15.--Monthly and annual mean discharge, in second-feet, of the Tongue River
at State line near Decker, Montana**

(Data from records of the U.S. Geological Survey, Water Resources Division)

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Annual |
|---------|------|------|------|------|------|------|-------|-------|-------|------|------|-------|--------|
| 1961 | 116 | 150 | 145 | 133 | 157 | 129 | 124 | 500 | 594 | 87.5 | 16.5 | 98.3 | 187 |
| 1962 | 270 | 223 | 191 | 190 | 298 | 263 | 525 | 1,009 | 1,651 | 460 | 187 | 241 | 458 |
| 1963 | 252 | 208 | 140 | 171 | 324 | 204 | 366 | 1,620 | 2,886 | 362 | 83.5 | 115 | 559 |
| 1964 | 130 | 195 | 150 | 153 | 157 | 181 | 341 | 1,291 | 2,817 | 814 | 152 | 228 | 549 |
| 1965 | 227 | 225 | 227 | 230 | 276 | 368 | 556 | 1,099 | 2,189 | 570 | 192 | 322 | 539 |
| 1966 | 306 | 221 | 151 | 108 | 156 | 242 | 265 | 762 | 342 | 90.2 | 55.9 | 74.2 | 232 |
| 1967 | 174 | 182 | 145 | 169 | 198 | 230 | 258 | 1,184 | 3,007 | 860 | 186 | 274 | 571 |
| 1968 | 295 | 261 | 193 | 254 | 402 | 391 | 283 | 884 | 3,165 | 651 | 475 | 615 | 652 |
| 1969 | 403 | 317 | 250 | 207 | 179 | 698 | 5,767 | 1,275 | 1,024 | 624 | 110 | 102 | 483 |
| 1970 | 247 | 258 | 235 | 176 | 250 | 386 | 528 | 1,964 | 2,931 | 599 | 161 | 239 | 664 |
| 1971 | 275 | 256 | 242 | 245 | 672 | 466 | 582 | 1,205 | 1,949 | 340 | 101 | 182 | 539 |
| 1972 | 310 | 291 | 211 | 210 | 280 | 855 | 382 | 1,048 | 1,346 | 393 | 249 | 269 | 487 |
| 1973 | 320 | 266 | 199 | 195 | 221 | 250 | 431 | 1,699 | 1,991 | 474 | 162 | 455 | 555 |
| 1974 | 383 | 324 | 236 | 330 | 269 | 239 | 461 | 1,108 | 1,550 | 376 | 187 | 225 | 474 |
| Average | 265 | 241 | 194 | 198 | 274 | 350 | 776 | 1,189 | 1,960 | 479 | 166 | 246 | 496 |

Table D-16.--Annual maximum crest-stage gage height and discharge for Spring Creek (FAS 314), Decker, Montana

(Data from U.S. Geological Survey, Water Resources Division)

| Year | Date | Gage height (feet) | Discharge (ft ³ /s) |
|------|----------|-----------------------|-----------------------------------|
| 1958 | June 7 | 3.40 | 184 |
| 1959 | Mar. 14 | 1.19 | 45 |
| 1960 | Mar. 19 | 1.31 | 49 |
| 1961 | ----- | ---- | ----- |
| 1962 | June 16 | 6.59 | 900 |
| 1963 | June 15 | 1.07 | 40 |
| 1964 | Apr. 22 | .05 | 15 |
| 1965 | Aug. 21 | 2.61 | 362 |
| 1966 | Sept. 26 | .11 | 15 |
| 1967 | June 12 | 2.81 | 390 |
| 1968 | June 9 | .72 | 130 |
| 1969 | Mar. 18 | 1.82 | 250 |
| 1970 | May 14 | 1.35 | 195 |
| 1971 | Feb. 14 | 6.50 | 1,400 |
| 1972 | Feb. 28 | 2.90 | 420 |
| 1973 | Sept. 1 | .26 | 20 |
| 1974 | Mar. 28 | 1.31 | 40 |

Table D-17.--Engineering data for the Tongue River Dam and Reservoir.

DAM:

| | |
|-------------------|-------------------------------------|
| Storage: | 69,439 A.F. |
| Spillway: | Width 350' |
| | Capacity 60,000 cfs |
| Gates: | 2 - 6' X 12' Slide -- Wet Tower |
| Height: | 91' |
| Length: | 1.824' |
| Type: | Earth Fill -- 1,225,000 cubic yards |
| Content Measuring | |
| Device: | Cable Down Face |
| Intitial Cost: | \$1,524,474.92 |

CANALS:

None

| | | |
|-----|-----------------|-----------------------|
| R/W | Reservoir Pool: | 3,497 Acres Deeded |
| | Reservoir Land: | 2,326.35 Acres Deeded |

APPENDIX E

VEGETATION

APPENDIX E

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| | | |
|------|-------------------------------------------------------------------------------------------------------------------------|------|
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|------|-------------------------------------------------------------------------------------------------------------------------|------|

Methodology of vegetation sampling (VTN Colorado, 1975a)

The Decker, Montana area of the Tongue River valley in southeastern Montana was topographically mapped by Continental Engineering and VTN Colorado, to a scale of one inch equals five hundred feet. Grid squares were placed on the map in accordance with the Montana Planimetric Land Measurement System, each square measuring 1,000 feet by 1,000 feet. In 1974 a sampling grid was drawn on Herculene corresponding to the land grid lines and numbered consecutively from the southeast corner of the study area by Decker Coal Company scientists. The grid was located on the ground by triangulation of landmarks using a Brunton compass.

Each grid square was sampled by twenty Daubenmire canopy coverage rectangular plots, each representing 1,000 square centimeters, randomly placed on two diagonal crossing of the square. Canopy coverage for each species was measured and recorded on specially designed sheets. Sample squares were chosen on criteria such as naturalness of community structure, and representativeness of natural communities existing in the area. Efforts were made to avoid such biasing factors as agricultural lands and surface disturbance.

All Daubenmire data was transferred to sample analysis sheets and analyzed for total and mean cover values both by species and for each sample square placement.

Vegetation was mapped on the 1" = 500' maps using aerial photographs and ground truth obtained from extensive on the ground reconnaissance surveys of all vegetation types. After the mapping was completed, the maps were ground checked for completeness and accuracy and then redrawn on 1" = 2000' USGS topo-sheets and photographically reduced for this report to a scale of 1" = 4000'.

Areas of Ponderosa Pine Badlands were surveyed and measured by describing a circle with a 15 meter radius around a randomly selected tree in each stand. All trees falling within the stand were then measured for diameter at breast height and these figures averaged by species for the proposed mining area. Areas of timber on the flood plain were surveyed for understory and overstory composition but not quantitatively measured because of limited economic value and growth forms not conducive to accurate analysis. No economically harvestable timber stands occur in the proposed mine area.

Range grazing capacity was analyzed by Wane Nipple, District Conservationist from the Big Horn County, Montana Soil Conservation Service District Office at Hardin, Montana. Established SCS survey methods were used and range site maps were retained by the Decker Coal Company and the Conservation District Office. The SCS method divides range lands by soil type rather than vegetation community, and thus is an index of grazing capacity rather than ecological diversity. Grazing data on BLM leases in the Decker area was received from the Miles City, Montana Bureau of Land Management offices.

Actual production was measured by clipping selected 1000 cm² areas of vegetation and bagging each species separately. Bags from each site were weighed air dry, and totals for both sample and species were averaged. Efforts were made to locate the sample plots in areas where range condition was at a maximum level, and equally dispersed among the vegetation types present in the area.

Table E-1 is a species list for the two proposed Decker mining areas. Tables E-2 through E-6 and E-8 through E-12 give the percent frequency, total cover and percent total cover for each of the major species within

each of the five vegetation types in the East Decker and North Extension areas respectively. Tables E-7 and E-13 give production data for each of the five types in the two proposed mining areas.

Table E-1.--Species list for the two proposed Decker mining areas
(Data from VTN Colorado, 1975a, 1975b)

| SCIENTIFIC NAME | COMMON NAME | ORIGIN (N=Native I=Introduced) |
|-----------------------------------|------------------------|--------------------------------------|
| TREES | | |
| <u>Acer negundo</u> | Boxelder maple | N |
| <u>Juniperus osteosperma</u> | Utah juniper | N |
| <u>Juniperus scopulorum</u> | Rockymountain juniper | N |
| <u>Pinus ponderosa</u> | Ponderosa pine | N |
| <u>Populus acuminata</u> | Lanceleaf poplar | N |
| <u>Populus sargentii</u> | Plains poplar | N |
| <u>Salix amygdaloides</u> | Peachleaf willow | N |
| <u>Salix exigua</u> | Coyote willow | N |
| SHRUBS | | |
| <u>Amorpha canescens</u> | Leadplant | N |
| <u>Artemisia cana</u> | Silver sagebrush | N |
| <u>Artemisia filifolia</u> | Sand sagebrush | N |
| <u>Artemisia tridentata</u> | Big sagebrush | N |
| <u>Atriplex gardneri</u> | Nuttall saltbush | N |
| <u>Atriplex argentea</u> | Silver saltbush | N |
| <u>Chrysothamnus nauseosus</u> | Rubber rabbitbrush | N |
| <u>Cleome serrulata</u> | Rockymountain beeplant | N |
| <u>Eurotia lanata</u> | Common winterfat | N |
| <u>Gutierrezia sarothrae</u> | Broom snakeweed | N |
| <u>Prunus hookeri</u> | Wildplum | N |
| <u>Prunus virginiana</u> | Western chokecherry | N |
| <u>Rhus trilobata</u> | Skunkbush sumac | N |
| <u>Ribes lacustre</u> | Prickly currant | N |
| <u>Rosa woodsii</u> | Wood's wildrose | N |
| <u>Symphoricarpos orbiculatus</u> | Western snowberry | N |
| FORBS | | |
| <u>Achillea lanulosa</u> | Western yarrow | N |
| <u>Ambrosia psyllostachya</u> | Western ragweed | N |
| <u>Artemisia frigida</u> | Fringed sagewort | N |
| <u>Artemisia ludoviciana</u> | Louisiana sagewort | N |
| <u>Astragalus mollissimus</u> | Woolly milkvetch | N |
| <u>Chrysopsis villosa</u> | Hairy goldenaster | N |
| <u>Cirsium arvense</u> | Canada thistle | N |
| <u>Cirsium flodmanii</u> | Flodman thistle | N |
| <u>Cirsium vulgare</u> | Bull thistle | N |
| <u>Descurainia pinnata</u> | Pinnate tansymustard | N |
| <u>Erigeron porteri</u> | Porter fleabane | N |
| <u>Eriogonum douglasi</u> | Douglas wildbuckwheat | N |
| <u>Grindelia squarrosa</u> | Curlycup gumweed | N |
| <u>Helianthus fendleriana</u> | Fendler sunflower | N |
| <u>Kochia scoparia</u> | Fireweed summercypress | N |

Table E-1 (Cont.).--Species list for the two proposed Decker mining areas
(VTN Colorado, 1975a, 1975b)

| SCIENTIFIC NAME | COMMON NAME | ORIGIN |
|-------------------------------|------------------------|--------|
| FORBS (Continued) | | |
| <u>Liatris punctata</u> | Dotted gay feather | N |
| <u>Melilotus officianalis</u> | Yellow sweetclover | I |
| <u>Opuntia polyacantha</u> | Plains pricklypear | N |
| <u>Oxytropis Lambertii</u> | Lambert locoweed | N |
| <u>Phlox hoodii</u> | Hood's phlox | N |
| <u>Plantago major</u> | Broadleaved plantain | N |
| <u>Plantago patagonica</u> | Wooly plantain | N |
| <u>Psoralea tenuiflora</u> | Fewflower scurf pea | N |
| <u>Rumex crispus</u> | Curly dock | N |
| <u>Salsola kali</u> | Common russianthistle | I |
| <u>Scolymus spp.</u> | Oyster plant | N |
| <u>Senecio douglasii</u> | Douglas groundsel | N |
| <u>Solanum rostratum</u> | Buffaloburr nightshade | N |
| <u>Solidago occidentalis</u> | Western goldenrod | N |
| <u>Sonchus asper</u> | Prickly sowthistle | N |
| <u>Sphaeralcea coccinea</u> | Scarlet globemallow | N |
| <u>Stanleya pinnata</u> | Prince's plume | N |
| <u>Suaeda depressa</u> | Pursh seepweed | N |
| <u>Xanthium spinosum</u> | Common Cocklebur | I |
| <u>Zigadenus nuttalli</u> | Nuttall deathcamus | N |
| GRASSES AND GRASS-LIKE PLANTS | | |
| <u>Agropyron albicans</u> | Montana wheatgrass | N |
| <u>Agropyron cristatum</u> | Crested wheatgrass | I |
| <u>Agropyron dasystachyum</u> | Thickspike wheatgrass | N |
| <u>Agropyron riparium</u> | Streambank wheatgrass | N |
| <u>Agropyron smithii</u> | Western wheatgrass | N |
| <u>Agropyron spicatum</u> | Bluebunch wheatgrass | N |
| <u>Agropyron trachycaulum</u> | Slender wheatgrass | N |
| <u>Andropogon scoparius</u> | Little bluestem | N |
| <u>Aristida longiseta</u> | Red threeawn | N |
| <u>Bouteloua curtipendula</u> | Side Oats grama | N |
| <u>Bouteloua gracilis</u> | Blue grama | N |
| <u>Bromus inermis</u> | Smooth brome | I |
| <u>Bromus japonicus</u> | Japanese brome | I |
| <u>Bromus tectorum</u> | Cheatgrass brome | I |
| <u>Calamovilfa longifolia</u> | Prairie sandreed | N |
| <u>Cares elionaris</u> | Blackrood sedge | N |
| <u>Carex filifolia</u> | Threadleaf sedge | N |
| <u>Dactylis glomerata</u> | Orchardgrass | I |
| <u>Elymus giganteus</u> | Mammoth wildrye | N |
| <u>Elymus triticoides</u> | Creeping wildrye | N |
| <u>Hordeum jubatum</u> | Foxtail barley | N |
| <u>Juncus balticus</u> | Baltic wirerush | I |
| <u>Koeleria cristata</u> | Prairie junegrass | N |
| <u>Oryzopsis bymenoides</u> | Indian ricegrass | N |
| <u>Poa arida</u> | Plains bluegrass | N |
| <u>Poa pratensis</u> | Kentucky bluegrass | N |
| <u>Poa secunda</u> | Sandberg bluegrass | N |

Table E-1 (Cont.)--Species list for the two proposed Decker mining areas.

| SCIENTIFIC NAME | COMMON NAME | ORIGIN |
|---------------------------------------|--------------------------|--------|
| GRASSES AND GRASS-LIKE PLANTS (Cont.) | | |
| <u>Phalaris canariensis</u> | Common canary grass | I |
| <u>Phleum pratense</u> | Common timothy | I |
| <u>Schedonnardus paniculatus</u> | Alkali tumblegrass | N |
| <u>Scirpus americanus</u> | American bulrush | N |
| <u>Sitanion hystrix</u> | Bottlebrush squirreltail | N |
| <u>Spartina pectinata</u> | Prairie cordgrass | N |
| <u>Sporobolus cryptandrus</u> | Sand dropseed | N |
| <u>Stipa comata</u> | Needle and thread | N |
| <u>Stipa viridula</u> | Green needlegrass | N |
| <u>Triglochin palustris</u> | Marsh arrowgrass | N |

Table E-2.--Canopy coverage and frequency of vegetation by species in the sagebrush steppe type on the East Decker area as determined by examination of 20 2 x 5 decimeter plots at each of 5 sites.

| Species Symbol | Percent Frequency | cm ² Total Cover | Percent Total Cover |
|----------------|-------------------|-----------------------------|---------------------|
| BRJA | 71 | 14,700 | 14.700 |
| ARTR | 63 | 31,950 | 31.950 |
| AGSM | 50 | 9,800 | 9.800 |
| BRTE | 11 | 2,550 | 2.550 |
| KOCR | 12 | 1,750 | 1.750 |
| OPPO | 7 | 1,650 | 1.650 |
| AGDA | 1 | 100 | .100 |
| STCO | 7 | 1,200 | 1.200 |
| STVI | 7 | 1,500 | 1.500 |
| ERPO | 1 | 100 | .100 |
| SPCO | 2 | 300 | .300 |
| POSE | 10 | 1,410 | 1.410 |
| CHLE | 1 | 50 | .050 |
| BOGR | 2 | 200 | .200 |
| PLPU (PA) | 1 | 200 | .200 |
| RAGN | 1 | 100 | .100 |
| CAMI | 1 | 100 | .100 |
| TRMA | 2 | 150 | .150 |
| ARFR | 1 | 10 | .010 |
| SPCR | 2 | 150 | .150 |
| ARCA | 1 | 100 | .100 |
| PSAR | 4 | 400 | .400 |
| AGAL | 2 | 200 | .200 |
| CA BU PA | 1 | 100 | .100 |

Table E-3 -- Canopy coverage and frequency of vegetation by species in the grassland-sagebrush type on the East Decker area as determined by examination of 20 2x5 decimeter plots on each of 5 sites.
(Data from VTN, Colorado 1975a)

| Species Symbol | Percent Frequency | cm ² Total Cover | Percent Total Cover |
|----------------|----------------------|--------------------------------|------------------------|
| AMPS | 10 | 1,000 | 1.000 |
| STCO | 52 | 13,050 | 13.050 |
| FEID | 7 | 700 | .700 |
| AGSP | 32 | 6,650 | 6.650 |
| CAFI | 29 | 6,450 | 6.450 |
| BRJA | 33 | 4,250 | 4.250 |
| GUSA | 14 | 3,250 | 3.250 |
| EREF | 2 | 1,350 | 1.350 |
| ARFR | 10 | 3,300 | 3.300 |
| ARFI | 1 | 100 | .100 |
| PEPU | 6 | 650 | .650 |
| BOGR | 31 | 4,350 | 4.350 |
| OPPO | 10 | 1,100 | 1.100 |
| SOAS | 2 | 200 | .200 |
| KOCR | 6 | 750 | .750 |
| PSTE | 4 | 1,500 | 1.500 |
| PHHO | 12 | 2,200 | 2.200 |
| CHVI | 3 | 300 | .300 |
| LIPU | 1 | 100 | .100 |
| OECA | 1 | 50 | .050 |
| POAR | 4 | 500 | .500 |
| PLPA | 4 | 300 | .300 |
| ERPO | 2 | 150 | .150 |
| SPCO | 2 | 150 | .150 |
| ASTE | 2 | 150 | .150 |
| AGCR | 1 | 100 | .100 |
| BRTE | 8 | 1,150 | 1.150 |
| PSAR | 4 | 700 | .700 |
| TRMA | 1 | 100 | .100 |
| MA SPP | 3 | 650 | .650 |
| HEAN | 1 | 100 | .100 |
| (FE) VUOC | 1 | 100 | .100 |
| ARTR | 1 | 100 | .100 |

Table E-4 -- Canopy coverage and frequency of vegetation by species in the mid-short-grass prairie type on the East Decker area as determined by examination of 20 2x5 decimeter plots at each of 5 sites.
(Data from VTN, Colorado 1975a)

| Species Symbol | Percent Frequency | cm ² Total Cover | Percent Total Cover |
|----------------|----------------------|--------------------------------|------------------------|
| STCO | 17 | 2,500 | 2.500 |
| BOCU | 54 | 14,150 | 14.150 |
| CAFI | 36 | 6,450 | 6.450 |
| AGSP | 27 | 5,050 | 5.050 |
| AMPS | 14 | 1,650 | 1.650 |
| ANSC | 23 | 6,250 | 6.250 |
| EREF | 3 | 350 | .350 |
| GUSA | 2 | 250 | .250 |
| PEPU | 7 | 950 | .950 |
| ARFR | 4 | 450 | .450 |
| PHHO | 4 | 330 | .330 |
| VIAM | 3 | 1,400 | 1.400 |
| BOGR | 8 | 2,400 | 2.400 |
| ASMO | 6 | 610 | .610 |
| BRJA | 15 | 1,510 | 1.510 |
| LARE | 14 | 1,450 | 1.450 |
| PSTE | 4 | 1,300 | 1.300 |
| ARLU | 1 | 100 | .100 |
| AGAL | 4 | 800 | .800 |
| CRBR | 3 | 150 | .150 |
| OECA | 1 | 100 | .100 |
| CALO | 13 | 4,400 | 4.400 |
| GRSQ | 2 | 300 | .300 |
| KOCR | 8 | 900 | .900 |
| POAR | 4 | 800 | .800 |
| SOMO | 2 | 700 | .700 |
| CHVI | 2 | 500 | .500 |
| OPPO | 2 | 600 | .600 |
| ARRO | 5 | 1,000 | 1.000 |
| MA SPP | 1 | 100 | .100 |
| UKN #1 | 2 | 200 | .200 |
| UKN #2 | 2 | 200 | .200 |

Table E-5 -- Canopy coverage and frequency of vegetation by species in the ponderosa pine-juniper type on the East Decker area as determined by examination of 20 2x5 decimeter plots at each of 5 sites.

| Species Symbol | Percent Frequency | cm ² Total Cover | Percent Total Cover |
|----------------|----------------------|--------------------------------|------------------------|
| ARTR | 5 | 1,350 | 1.350 |
| BRJA | 30 | 5,450 | 5.450 |
| SPCO | 2 | 200 | .200 |
| AGSP | 31 | 7,850 | 7.850 |
| BRTE | 10 | 2,750 | 2.750 |
| BOGR | 3 | 400 | .400 |
| CHVI | 1 | 50 | .050 |
| PEPU | 1 | 50 | .050 |
| BOCU | 12 | 3,300 | 3.300 |
| ARFR | 11 | 2,200 | 2.200 |
| RHTR | 3 | 250 | .250 |
| KOCR | 13 | 2,700 | 2.700 |
| ANSC | 4 | 900 | .900 |
| GUSA | 7 | 750 | .750 |
| CAFI | 8 | 800 | .800 |
| STCO | 6 | 1,000 | 1.000 |
| SYOR | 3 | 1,100 | 1.100 |
| ARLU | 3 | 500 | .500 |
| ERPO | 1 | 100 | .100 |
| CALO | 5 | 2,000 | 2.000 |
| ARCA | 6 | 1,300 | 1.300 |
| CRBR | 1 | 50 | .050 |
| AGAL | 11 | 2,650 | 2.650 |
| POSE | 1 | 300 | .300 |
| AGSM | 5 | 600 | .600 |
| FEID | 5 | 450 | .450 |
| ASMO | 1 | 100 | .100 |
| STVI | 2 | 1,400 | 1.400 |
| LIPU | 1 | 100 | .100 |
| PIPO | 1 | 900 | .900 |
| AGSA | 1 | 100 | .100 |
| RILA | 1 | 1,000 | 1.000 |
| PRVI | 1 | 1,000 | 1.000 |
| JUSC | 1 | 1,000 | 1.000 |

Table E-6.--Canopy coverage and frequency of vegetation by species in the riparian shrub-grassland type on the East Decker area as determined by examination of 20 2 x 5 decimeter plots at each of 5 sites. (Data from VTN Colorado, 1975a)

| Species Symbol | Percent Frequency | cm ² Total cover | Percent Total cover |
|----------------|-------------------|-----------------------------|---------------------|
| STVI | 41 | 9,900 | 9.900 |
| AGSM | 66 | 17,400 | 17.400 |
| SPCO | 12 | 2,300 | 2.300 |
| ARCA | 48 | 21,200 | 21.200 |
| OPPO | 1 | 100 | .100 |
| STCO | 11 | 1,800 | 1.800 |
| LARE | 1 | 300 | .300 |
| BRJA | 44 | 7,400 | 7.400 |
| BOGR | 5 | 2,900 | 2.900 |
| POPR | 7 | 1,300 | 1.300 |
| ARLU | 13 | 4,600 | 4.600 |
| POSE | 18 | 2,600 | 2.600 |
| ARTR | 1 | 500 | .500 |
| MEOF | 8 | 2,100 | 2.100 |
| KOCR | 2 | 200 | .200 |
| ARFI | 1 | 300 | .300 |
| ASSP | 1 | 100 | .100 |
| AGDA | 4 | 1,400 | 1.400 |
| AGCR | 9 | 3,400 | 3.400 |
| CAMI | 2 | 200 | .200 |
| CA BU PA | 2 | 200 | .200 |

Table E-7.--Vegetation production in the East Decker area 1975. (Data from VTN Colorado, 1975a)

| | Growth Form | Sagebrush Steppe | Mid-short-grass Prairie | Grassland-Sagebrush | Riparian Shrub-Grassland | Ponderosa Pine-Juniper |
|-------------|---------------------|------------------|-------------------------|---------------------|--------------------------|------------------------|
| Total Grams | Shrubs | 8205 | 218 | 259 | 39055 | 2939 |
| | Leaders | 2311 | - | - | - | - |
| | Forbs | 1945 | 1073 | 1208 | 605 | 346 |
| | Annual | 691 | 189 | 288 | 570 | 508 |
| | Grasses | 1147 | 1957 | 423 | 7977 | 1265 |
| | Perennials | | | | | |
| Raw g | \bar{X} Annual Pr | 121.880 | 68.740 | 191.900 | 183.040 | 42.400 |
| | \bar{X} Woody Pr | 164.100 | - | - | 781.000 | 58.780 |
| | \bar{X} Total | 258.980 | 68.740 | 191.900 | 964.040 | 100.980 |
| lbs/ac | \bar{X} Annual Pr | 2684.581 | 1514.096 | 1408.957 | 4031.718 | 929.515 |
| | \bar{X} Woody Pr | 3614.537 | - | - | 17202.643 | 1294.713 |
| | \bar{X} Total | 6299.118 | 1514.096 | 1408.957 | 21234.361 | 2224.229 |

Table E-8 -- Canopy coverage and frequency by species in the sagebrush steppe type on the North Extension area. (Data from VTN, Colorado 1975b)

| SPECIES SYMBOL | RAW FREQUENCY | PERCENT FREQUENCY | RAW TOTAL CANOPY COVERAGE | PERCENT TOTAL CANOPY COVERAGE |
|-------------------|------------------|----------------------|------------------------------|----------------------------------|
| STVI | 1 | 1% | 300 | .300% |
| ARTR | 44 | 44% | 19,950 | 19.950% |
| BRJA | 54 | 54% | 10,850 | 10.850% |
| ACPA | 3 | 3% | 250 | .250% |
| POAR | 11 | 11% | 1,190 | 1.190% |
| PHHO | 5 | 5% | 400 | .400% |
| STCO | 41 | 41% | 11,650 | 11.650% |
| CAMI | 3 | 3% | 500 | .500% |
| OPPO | 3 | 3% | 700 | .700% |
| AGSM | 39 | 39% | 5,600 | 5.600% |
| CABUPA | 1 | 1% | 100 | .100% |
| PLPU | 2 | 2% | 250 | .250% |
| EULA | 5 | 5% | 500 | .500% |
| HEHI | 3 | 3% | 400 | .400% |
| HAHI | 1 | 1% | .00 | .100% |
| KOCR | 3 | 3% | 400 | .400% |
| AGAL | 7 | 7% | 900 | .900% |
| BOGR | 18 | 18% | 6,000 | 6.000% |
| ARFR | 5 | 5% | 950 | .950% |
| BRTE | 1 | 1% | 100 | .100% |
| ARCA | 4 | 4% | 300 | .300% |
| TRMA | 1 | 1% | 50 | .050% |
| ACLA | 2 | 2% | 300 | .300% |
| CAFI | 14 | 14% | 3,150 | 3.150% |
| HEAN | 1 | 1% | 50 | .050% |
| SPCO | 1 | 1% | 100 | .100% |
| FEOC | 2 | 2% | 200 | .200% |
| PLPA | 3 | 3% | 300 | .300% |
| TRMA (DU) | 3 | 3% | 300 | .300% |
| UKN BORAGE | 1 | 1% | 200 | .200% |

Table E-9 -- Canopy coverage and frequency by species in the grassland-sage-brush type on the North Extension area. (Data from VTN, Colorado 1975b)

| SPECIES SYMBOL | RAW FREQUENCY | PERCENT FREQUENCY | RAW TOTAL CANOPY COVERAGE | PERCENT TOTAL CANOPY COVERAGE |
|-------------------|------------------|----------------------|------------------------------|----------------------------------|
| GUSA | 46 | 46% | 10,535 cm ² | 10.535% |
| STCO | 44 | 44% | 10,250 cm ² | 10.250% |
| POAR | 5 | 5% | 500 cm ² | .500% |
| ARFR | 21 | 21% | 4,450 cm ² | 4.450% |
| SEDE | 8 | 8% | 900 cm ² | .900% |
| AGSP | 28 | 28% | 3,450 cm ² | 3.450% |
| BRJA | 16 | 16% | 2,200 cm ² | 2.200% |
| DEPI | 2 | 2% | 650 cm ² | .650% |
| EREF | 1 | 1% | 50 cm ² | .050% |
| PEPU | 4 | 4% | 170 cm ² | .170% |
| CALO | 14 | 14% | 1,450 cm ² | 1.450% |
| CAFI | 20 | 20% | 4,350 cm ² | 4.350% |
| ASMO | 2 | 2% | 150 cm ² | .150% |
| PHHO | 12 | 12% | 1,700 cm ² | 1.700% |
| CHVI | 5 | 5% | 760 cm ² | .760% |
| FOCE | 4 | 4% | 370 cm ² | .370% |
| PEPA | 1 | 1% | 20 cm ² | .020% |
| ERCE | 2 | 2% | 150 cm ² | .150% |
| CABUPA | 1 | 1% | 60 cm ² | .060% |
| ARTR | 17 | 17% | 6,400 cm ² | 6.400% |
| PSAR | 4 | 4% | 400 cm ² | .400% |
| CRBR | 1 | 1% | 100 cm ² | .100% |
| OPPO | 1 | 1% | 100 cm ² | .100% |
| AGAL | 3 | 3% | 300 cm ² | .300% |
| BOGR | 10 | 10% | 2,300 cm ² | 2.300% |
| OECA | 1 | 1% | 200 cm ² | .200% |

Table E-10 -- Canopy coverage and frequency by species in the mid-short grass prairie type on the North Extension area. (Data from VTN, Colorado 1975 b)

| SPECIES SYMBOL | RAW FREQUENCY | PERCENT FREQUENCY | RAW TOTAL CANOPY COVERAGE | PERCENT TOTAL CANOPY COVERAGE |
|-------------------|------------------|----------------------|------------------------------|----------------------------------|
| AGSP | 46 | 46% | 9,850 cm ² | 9,850% |
| CAFI | 29 | 29% | 5,200 cm ² | 5.200% |
| STCO | 7 | 7% | 800 cm ² | .800% |
| EREF | 2 | 2% | 150 cm ² | .150% |
| ANSC | 31 | 31% | 8,300 cm ² | 8.300% |
| PHHO | 24 | 24% | 3,250 cm ² | 3.250% |
| GUSA | 49 | 49% | 7,600 cm ² | 7.600% |
| ANRO | 4 | 4% | 700 cm ² | 700% |
| AGAL | 2 | 2% | 400 cm ² | 400% |
| KOCR | 8 | 8% | 1,150 cm ² | 1.150% |
| PEPU | 1 | 1% | 100 cm ² | .100% |
| PEPA* | 2 | 2% | 150 cm ² | .150% |
| CRBR | 2 | 2% | 200 cm ² | .200% |
| ARFR | 4 | 4% | 400 cm ² | .400% |
| BRJA | 4 | 4% | 450 cm ² | .450% |
| ASMO | 4 | 4% | 550 cm ² | .550% |
| RHTR | 1 | 1% | 900 cm ² | .900% |
| LIPU | 1 | 1% | 50 cm ² | .050% |
| SOAS | 1 | 1% | 100 cm ² | .100% |
| CHVI | 3 | 3% | 1,100 cm ² | 1.100% |
| MEHI | 1 | 1% | 200 cm ² | .200% |
| BOGR | 4 | 4% | 500 cm ² | .500% |
| CAMO | 5 | 5% | 500 cm ² | .500% |
| NEHI | 3 | 3% | 250 cm ² | .250% |
| ERPO | 2 | 2% | 150 cm ² | .150% |
| AGSA | 1 | 1% | 50 cm ² | .050% |
| OECA | 1 | 1% | 50 cm ² | .050% |
| ARLO | 5 | 5% | 650 cm ² | .650% |
| ARTR | 6 | 6% | 2,000 cm ² | 2.000% |
| VUOC | 1 | 1% | 100 cm ² | .100% |
| YUGL | 1 | 1% | 600 cm ² | .600% |
| CALO | 6 | 6% | 1,600 cm ² | 1.600% |
| ASTE | 1 | 1% | 100 cm ² | .100% |
| ARFI | 1 | 1% | 100 cm ² | .100% |
| ARFR | 1 | 1% | 100 cm ² | .100% |
| AS SPP | 1 | 1% | 100 cm ² | .100% |
| ARDR | 1 | 1% | 100 cm ² | .100% |

Table E-11 -- Canopy coverage and frequency by species in the ponderosa pine-juniper type on the North Extension area. (Data from VTN, Colorado 1975b)

| SPECIES SYMBOL | RAW FREQUENCY | PERCENT FREQUENCY | RAW TOTAL CANOPY COVERAGE | PERCENT TOTAL CANOPY COVERAGE |
|-------------------|------------------|----------------------|------------------------------|----------------------------------|
| GUSA | 11 | 11% | 2,100 | 2.100% |
| RHTR | 2 | 2% | 1,000 | 1.000% |
| SYOR | 1 | 1% | 100 | .100% |
| ARTR | 8 | 8% | 2,850 | 2.850% |
| ACLA | 1 | 1% | 200 | .200% |
| AGSM | 2 | 2% | 400 | .400% |
| CAFI | 6 | 6% | 1,000 | 1.000% |
| ARLO | 3 | 3% | 600 | .600% |
| AGSP | 36 | 36% | 6,300 | 6.300% |
| PEPA* | 1 | 1% | 100 | .100% |
| AS SPP* | 2 | 2% | 150 | .150% |
| ARFR | 1 | 1% | 200 | .200% |
| CRBR | 2 | 2% | 100 | .100% |
| BOGR | 1 | 1% | 100 | .100% |
| CALO | 1 | 1% | 600 | .600% |
| ANSC | 1 | 1% | 200 | .200% |
| BRTE | 4 | 4% | 1,150 | 1.150% |
| BRJA | 2 | 2% | 400 | .400% |
| CABUPA | 1 | 1% | 50 | .050% |
| ERPO | 2 | 2% | 150 | .150% |
| PIPO | 3 | 3% | 3,000 | 3.000% |
| KOCR | 1 | 1% | 100 | .100% |
| PHHO | 4 | 4% | 500 | .500% |
| PSAR | 1 | 1% | 50 | .050% |
| SIMI | 1 | 1% | 100 | .100% |
| CEAR | 4 | 4% | 700 | .700% |
| STVI | 1 | 1% | 200 | .200% |
| LILE | 1 | 1% | 50 | .050% |
| CAMO | 2 | 2% | 150 | .150% |
| ASMO | 1 | 1% | 100 | .100% |
| CHVI | 2 | 2% | 500 | .500% |
| PEPU | 1 | 1% | 600 | .600% |

Table E-12 -- Canopy coverage and frequency by species in the riparian shrub-grassland type on the North Extension area. (Data from VTN, Colorado 1975b)

| SPECIES SYMBOL | RAW FREQUENCY | PERCENT FREQUENCY | RAW TOTAL CANOPY COVERAGE | PERCENT TOTAL CANOPY COVERAGE |
|---------------------------|--------------------------|------------------------------|--------------------------------------|------------------------------------------|
| ARCA | 33 | 33% | 19,700 | 19.700% |
| AGSM | 29 | 29% | 6,500 | 6.500% |
| BRJA | 36 | 36% | 8,000 | 8.000% |
| STVI | 7 | 7% | 1,100 | 1.100% |
| THAR | 1 | 1% | 100 | .100% |
| HEHI | 1 | 1% | 100 | .100% |
| AGCR | 9 | 9% | 2,750 | 2.750% |
| AGTR | 11 | 11% | 2,400 | 2.400% |
| DEPI | 7 | 7% | 2,800 | 2.800% |
| ELGI | 1 | 1% | 800 | .800% |
| TRMA (DU) | 6 | 6% | 900 | .900% |
| ACLA | 4 | 4% | 400 | .400% |
| KOSC | 3 | 3% | 1,100 | 1.100% |
| ARLU | 5 | 5% | 1,600 | 1.600% |
| ARVU | 1 | 1% | 400 | .400% |
| MEHI | 5 | 5% | 600 | .600% |
| BRTE | 9 | 9% | 1,900 | 1.900% |
| CHLE | 1 | 1% | 400 | .400% |
| POSE | 4 | 4% | 1,400 | 1.400% |
| CAMI | 3 | 3% | 300 | .300% |
| ASTER SPP | 1 | 1% | 100 | .100% |

Table E-13 -- Mean annual live weight production in pounds per acre for the 5 community types on the North Extension area. (Data from VTN, Colorado 1975b)

| | \bar{X} Production Riparian Shrub Grassland | \bar{X} Production Ponderosa Pine Juniper | \bar{X} Production Mid-Shortgrass Prairie | \bar{X} Production Sagebrush Steppe | \bar{X} Production Grassland Sagebrush |
|------------------------------------------------|-----------------------------------------------------|---------------------------------------------------|---------------------------------------------------|---------------------------------------------|------------------------------------------------|
| Annual Grasses | 235.6 | 32.2 | 39.6 | 322.1 | 112.7 |
| Perennial Grasses | 1,526.6 | 264.2 | 686.7 | 537.8 | 333.4 |
| Forbs | 545.3 | 299.5 | 357.6 | 1,380.1 | 374.4 |
| Shrubs | 3,429.6 | 2,761.3 | 1,294.2 | 10,662.9 | 3,160.7 |
| Leaders | 1,692.0 | 88.8 | 7.9 | 288.5 | 299.5 |
| Trees | 0.0 | 4,118.9 | 0.0 | 0.0 | 0.0 |
| Total Production Live Weight Pounds/Acre | 7,465.1 | 7,564.9 | 2,386.0 | 13,191.4 | 4,280.7 |

APPENDIX F

WILDLIFE AND FISHERIES

APPENDIX F

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Methodology for gathering information on terrestrial wildlife (Montana Fish and Game Department)

To gather information on mule deer, white-tailed deer and antelope, systematic routes were established and traveled at least once a week, morning and evening. Information recorded included date, time of observation (military time), location (Township, range, Section), number of animals seen, sex, age (adult or juvenile-young of the year), habitat type used, slope, aspect, and weather parameters (estimated temperature (⁰F), wind direction, estimated wind velocity, type of precipitation and cloud cover). Vehicle route information on the first seven parameters was supplemented with aerial flight information each month. The combined information was then used to determine distribution patterns, use of habitat types, and population characteristics (fawns/100 does, bucks/100 does). Additional information for determining these parameters was furnished from flights made by Sam Scott (Decker Coal Co.) and Steve Knapp (Montana Fish and Game Department).

During the course of daily travels, information on upland game birds, waterfowl, raptors, song and shore birds, predators, and other nongame mammals was also noted. This information included date, time, location, numbers, sex, age, and habitat use for upland game birds and geese and date, location, and numbers for the other groups mentioned above. Where appropriate, these data were used to determine distribution patterns and population parameters.

Table F-1.-Use of Habitat Types by Mule Deer, Antelope and White-tailed Deer in the Decker Area by Season for the Period January 1974 through September 1975.

| | | Sagebrush Grassland Steppe | | Mid-Short Grass | | Ponderosa Prairie | | Pine-Badlands Riparian | | Agricultural Reclamation | | Number of Observations | |
|-------------------|--------------------|----------------------------|--------|-----------------|-------|-------------------|------|------------------------|------|--------------------------|--|------------------------|--|
| Mule Deer | | | | | | | | | | | | | |
| Winter | 30-60 ¹ | 7-14 | -- | -- | 7-14 | 1- 2 | -- | -- | 5-10 | | | 50 | |
| Spring | 45-67 | 8-12 | 1- 1.5 | 4- 6 | 6- 9 | 1- 1.5 | 2- 3 | | | | | 67 | |
| Summer | 52-26 | 24-12 | 10- 5 | 27-14 | 67-34 | 15- 8 | 2- 1 | | | | | 197 | |
| Fall | 4-40 | 1-10 | -- | -- | -- | 3-30 | 2-20 | | | | | 10 | |
| | | | | | | | | | | | | | |
| Antelope | | | | | | | | | | | | | |
| Winter | 22-65 | 5-15 | 6-18 | 1- 2 | -- | -- | -- | | | | | 34 | |
| Spring | 43-52 | 10-12 | 10-12 | 12-14 | 2- 3 | 6- 7 | -- | | | | | 83 | |
| Summer | 43-31 | 28-20 | 28-20 | 8- 6 | 2- 3 | 28-20 | -- | | | | | 137 | |
| Fall | -- | -- | -- | -- | -- | -- | -- | | | | | -- | |
| | | | | | | | | | | | | | |
| White-tailed Deer | | | | | | | | | | | | | |
| Winter | 1-25 | -- | -- | -- | -- | 3-75 | -- | | | | | 4 | |
| Spring | -- | -- | -- | -- | 1-50 | 1-50 | -- | | | | | 2 | |
| Summer | 1- 1 | 1- 1 | -- | -- | 8-47 | 7-41 | -- | | | | | 17 | |
| Fall | -- | -- | -- | -- | -- | 3-100 | -- | | | | | 3 | |

¹ Number of observations - Percent of observations

Table F-2.-Population Characteristics of Mule Deer, Antelope, and White-tailed Deer in the Decker Area by Season for the Period January 1974 through September 1975.

| Males | | | | | | | | | | | | | | | Females | | | | | | | | | | | | | | | Fawns | | | | | | | | | | | | | | | Unclassified | | | | | | | | | | | | | | | Fawns/100 Females | | | | | | | | | | | | | | | Males/100 Females | | | | | | | | | | | | | | | Number of Total Number | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|---------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Males | | | | | | | | | | | | | | | Females | | | | | | | | | | | | | | | Fawns | | | | | | | | | | | | | | | Unclassified | | | | | | | | | | | | | | | Fawns/100 Females | | | | | | | | | | | | | | | Males/100 Females | | | | | | | | | | | | | | | Observation | | | | | | | | | | | | | | | Observed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mule Deer | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Winter | | | | | | | | | | | | | | | - | | | | | | | | | | | | | | | 4 | | | | | | | | | | | | | | | 5 | | | | | | | | | | | | | | | 413 | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | 49 | | | | | | | | | | | | | | | 422 | | | | | | | | | | | | | | |
| Spring | | | | | | | | | | | | | | | 8 | | | | | | | | | | | | | | | 70 | | | | | | | | | | | | | | | 7 | | | | | | | | | | | | | | | 484 | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | 111 | | | | | | | | | | | | | | | 569 | | | | | | | | | | | | | | |
| Summer | | | | | | | | | | | | | | | 95 | | | | | | | | | | | | | | | 466 | | | | | | | | | | | | | | | 89 | | | | | | | | | | | | | | | 24 | | | | | | | | | | | | | | | 19 | | | | | | | | | | | | | | | 20 | | | | | | | | | | | | | | | 262 | | | | | | | | | | | | | | | 674 | | | | | | | | | | | | | | |
| Fall | | | | | | | | | | | | | | | 8 | | | | | | | | | | | | | | | 11 | | | | | | | | | | | | | | | 9 | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | 9 | | | | | | | | | | | | | | | 28 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Antelope | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Winter | | | | | | | | | | | | | | | 18 | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | 633 | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | 33 | | | | | | | | | | | | | | | 651 | | | | | | | | | | | | | | |
| Spring | | | | | | | | | | | | | | | 28 | | | | | | | | | | | | | | | 99 | | | | | | | | | | | | | | | 36 | | | | | | | | | | | | | | | 202 | | | | | | | | | | | | | | | 36 | | | | | | | | | | | | | | | 28 | | | | | | | | | | | | | | | 93 | | | | | | | | | | | | | | | 401 | | | | | | | | | | | | | | |
| Summer | | | | | | | | | | | | | | | 245 | | | | | | | | | | | | | | | 770 | | | | | | | | | | | | | | | 386 | | | | | | | | | | | | | | | 30 | | | | | | | | | | | | | | | 50 | | | | | | | | | | | | | | | 32 | | | | | | | | | | | | | | | 184 | | | | | | | | | | | | | | | 1431 | | | | | | | | | | | | | | |
| Fall | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | |
| White-tailed Deer | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Winter | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | 8 | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | 15 | | | | | | | | | | | | | | | 25 | | | | | | | | | | | | | | | 25 | | | | | | | | | | | | | | | 4 | | | | | | | | | | | | | | | 27 | | | | | | | | | | | | | | |
| Spring | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | 26 | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | 26 | | | | | | | | | | | | | | |
| Summer | | | | | | | | | | | | | | | 12 | | | | | | | | | | | | | | | 24 | | | | | | | | | | | | | | | 12 | | | | | | | | | | | | | | | 3 | | | | | | | | | | | | | | | 50 | | | | | | | | | | | | | | | 50 | | | | | | | | | | | | | | | 6 | | | | | | | | | | | | | | | 51 | | | | | | | | | | | | | | |
| Fall | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | 10 | | | | | | | | | | | | | | | 7 | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | -- | | | | | | | | | | | | | | | 3 | | | | | | | | | | | | | | | 17 | | | | | | | | | | | | | | |

Table F-3.-Use of Habitat Types by Sage Grouse and Sharp-tailed Grouse in the Decker Area by Season for the Period January 1974 through September 1975.

| | Mid-Short Grass | | | Number of | |
|----------------------------|-------------------|---------------------|---------|-----------------------|--------|
| | Sagebrush Steppe | Grassland-Sagebrush | Prairie | Agricultural Roadside | Total |
| <u>Sage Grouse</u> | | | | Observations | Number |
| Winter | 4-80 ¹ | 1-20 | -- | -- | 5 |
| Spring | 11-79 | 3-21 | -- | -- | 14 |
| Summer | 11-48 | 4-17 | 4-17 | 1-5 | 23 |
| Fall | -- | -- | -- | 3-13 | 138 |
| | | | | | -- |
| <u>Sharp-tailed Grouse</u> | | | | | |
| Winter | -- | -- | -- | -- | -- |
| Spring | 8-80 | 2-20 | -- | -- | 10 |
| Summer | 4-30 | 1- 8 | 7-54 | 1-8 | 13 |
| Fall | -- | -- | -- | -- | 101 |
| | | | | | -- |

¹ Number of observations - Percent of Observations

Table F-4. - Population Characteristics of Sage Grouse and Sharp-tailed Grouse
by Season for 1974 and 1975.

| | Males | Females | Juveniles | Unclassified |
|----------------------------|-----------------|-----------------|-----------|--------------|
| <u>Sage Grouse</u> | | | | |
| Winter | 40 ¹ | -- | -- | -- |
| Spring | 182 | 130 | -- | -- |
| | | 4 ² | 6 | -- |
| Summer | 3 | 13 ³ | 63 | 50 |
| Fall | -- | -- | -- | -- |
| <u>Sharp-tailed Grouse</u> | | | | |
| Winter | -- | -- | -- | -- |
| Spring | 89 ⁴ | 29 | -- | 54 |
| | | 3 | 5 | 27 |
| Summer | -- | 1 | 27 | 38 |
| Fall | -- | -- | -- | -- |

¹ 1974 and 1975 combined

² 1974

³ 1975

⁴ 1975 only

Table F-5.-Canada Goose Observations in the Decker Area from March 1974 through September 1975.

| Number of Geese | Date | Location |
|-----------------|---------|----------------------------------|
| 35 | 3-15-74 | T9S, R40E, S14, SW $\frac{1}{4}$ |
| 138 | 9-04-74 | T9S, R40E, S15, SE $\frac{1}{4}$ |
| 61 | 9-23-74 | T8S, R40E, S35, NW $\frac{1}{4}$ |
| 1 | 9-24-74 | T9S, R40E, S4, NE $\frac{1}{4}$ |
| 60 | 9-13-74 | T9S, R40E, S14, NW $\frac{1}{4}$ |
| 27 | 3-04-75 | T9S, R40E, S11, SW $\frac{1}{4}$ |
| 102 | 4-02-75 | T9S, R40E, S11, SE $\frac{1}{4}$ |
| 18 | 7-22-75 | T9S, R40E, S15, NE $\frac{1}{4}$ |
| 22 | 7-24-75 | T9S, R40E, S15, NE $\frac{1}{4}$ |
| 23 | 7-25-75 | T9S, R40E, S1, NW $\frac{1}{4}$ |
| 58 | 8-01-75 | T9S, R40E, S3, NW $\frac{1}{4}$ |
| 43 | 8-11-75 | T9S, R40E, S11, NE $\frac{1}{4}$ |
| 11 | 8-12-75 | T9S, R40E, S22, NE $\frac{1}{4}$ |
| 52 | 8-12-75 | T9S, R40E, S15, SE $\frac{1}{4}$ |
| 22 | 8-23-75 | T9S, R40E, S15, SE $\frac{1}{4}$ |
| 60 | 8-27-75 | T9S, R40E, S11, NW $\frac{1}{4}$ |
| 120 | 9-09-75 | T9S, R40E, S3, NE $\frac{1}{4}$ |
| 153 | 9-10-75 | T9S, R40E, S11, SW $\frac{1}{4}$ |
| 145 | 9-15-75 | T9S, R40E, S14, NW $\frac{1}{4}$ |

Fishery studies of the Tongue River Reservoir (Montana Department of Fish and Game)

The objectives of these studies were to inventory fish populations of the Tongue River Reservoir to determine species composition, distribution, and relative abundance of major sport fishes; to determine angler use and catch statistics; and to evaluate possible impacts of proposed coal development on the reservoir.

During the ice-free period, water sampling was conducted on the reservoir on a biweekly basis. Three stations were established within the reservoir, and samples were also collected from influent and effluent waters. Sampling points for the reservoir are located near the dam at midlake and near the upper end of the reservoir; influent waters were sampled from the Tongue River above the reservoir and at the mine discharge; and effluent waters were sampled downstream from the Tongue River Dam (fig. 58). The Montana Cooperative Fishery Research Unit is determining chemical and physical parameters, sediment chemical parameters, and certain biological parameters (R. W. Gregory, personal communication).

Fish were collected using 1.22 meter (4-foot) by 1.83 meter (6-foot) frame trap nets with 1.27 cm (1/2-inch) and 0.63 cm (1/4-inch) mesh webbing and 15.3 meter (50 foot) leads; 38 meter (125-foot) experimental gill nets; a 30.5 meter (100-foot), 0.63 cm (1/4-inch) beach seine and a 15.3 meter (150-foot), 0.63 cm (1/4-inch) bag seine. Fish were also sampled with hook and line. Lengths and weights were taken from captured fish, and sport fish were tagged with numbered Floy-anchor tags. Scales were taken for analysis of age and growth.

Population size of black and white crappie and northern pike was estimated from fish captured during the spring trap net season. The

modified Schnabel estimator, employing the expression $N = \frac{\sum (C_t M_t)}{R_t + 1}$, where N = estimated fish in population, C_t = number of fish caught, M_t = marked fish at large, and R_t number of recaptures (Chapman and Overton, 1966). Confidence limits ($P = 0.05$) were computed according to Formula 4 of Chapman and Overton (1966).

A partial creel census was initiated on the reservoir in April 1975. A creel check station was established on the primary access road to the reservoir. Signs instructing fishermen to stop were erected on the approach to the station. Fishermen were interviewed to determine distance traveled, gender, license type, total hours fished, fishing method, bait, shore or boat, number of fish caught, and number of fish released. Lengths, weights, and scales were taken on fish which had not been dressed. The station was operated one weekday and one weekend day each week, alternating each week.

Trap netting

Frame trap nets were fished during April and May in 1972, 1973, and 1974 and during April through June in 1975 to establish indices of spawning strength of sport fish populations in the reservoir. Traps were fished for 85, 121, 168, and 197 nights in 1972, 1973, 1974, and 1975, respectively. The reservoir was divided into three zones (Figure 58), and the traps were fished in areas that appeared to be good spawning habitat. As catch rates diminished or water levels changed, traps were moved to other locations. Game fish were tagged, and black and white crappie were marked by removing the left pelvic fin.

A total of 19 species representing six families have been taken during the spring trap net season. Trap net catches for the years 1972 through 1975 are compared in Table 22. The catch rates (fish/trap night) for 1972,

1973, and 1974 were similar, while the 1975 catch rate was about 3 times larger. The greater catch rate in 1975 is probably due to June sampling which resulted in a larger catch of white crappie. Carp were the predominant fish in the 1972 sample (37.1 percent of the total) with yellow perch dominant in 1973 (28.6 percent). White crappie predominated in 1973 and 1974, making up 48.6 and 65.5 percent of the totals respectively. Catch rates for white crappie have increased from 1.99 fish per net night in 1972 to 29.95 fish per net night in 1975.

Game fish made up 3.3 percent of the total catch in 1975 as compared to 8.7 percent in 1974. The 1975 catch rate is similar to the 1972 and 1973 game fish catches. Catch statistics and average lengths and weights of northern pike and walleye for 1972-1975 are shown in Table F-6, and catch rates per zone are shown for all species in Table 23.

Northern pike were taken almost exclusively in Zone A with these traps accounting for 91.5 percent of the northern catch. This area with shallow bays is obviously best suited for northern pike reproduction. The northern catch was greatest during May (55.1 percent) followed by April (39.2

Table F-6 - Average lengths and weights of northern pike and walleye caught in trap nets in the Tongue River Reservoir, 1972-1975.

| Year | No. ^{1/} | Avg. Length (mm) | Range (mm) | Avg. Weight (grams) | No. ^{1/} | Avg. Length (mm) | Range (mm) | Avg. Weight (grams) |
|------|-------------------|------------------------|---------------|---------------------------|-------------------|------------------------|---------------|---------------------------|
| 1972 | 29 | 747 | 597-1,080 | 3,746 | 32 | 495 | 358-569 | 1,335 |
| 1973 | 48 | 732 | 648-1,189 | 3,750 | 24 | 541 | 363-645 | 1,643 |
| 1974 | 140 | 719 | 394-1,156 | 2,937 | 44 | 511 | 305-799 | 1,507 |
| 1975 | 136 | 808 | 282-1,301 | 3,083 | 90 | 470 | 269-813 | 1,217 |

^{1/} Does not include returned fish.

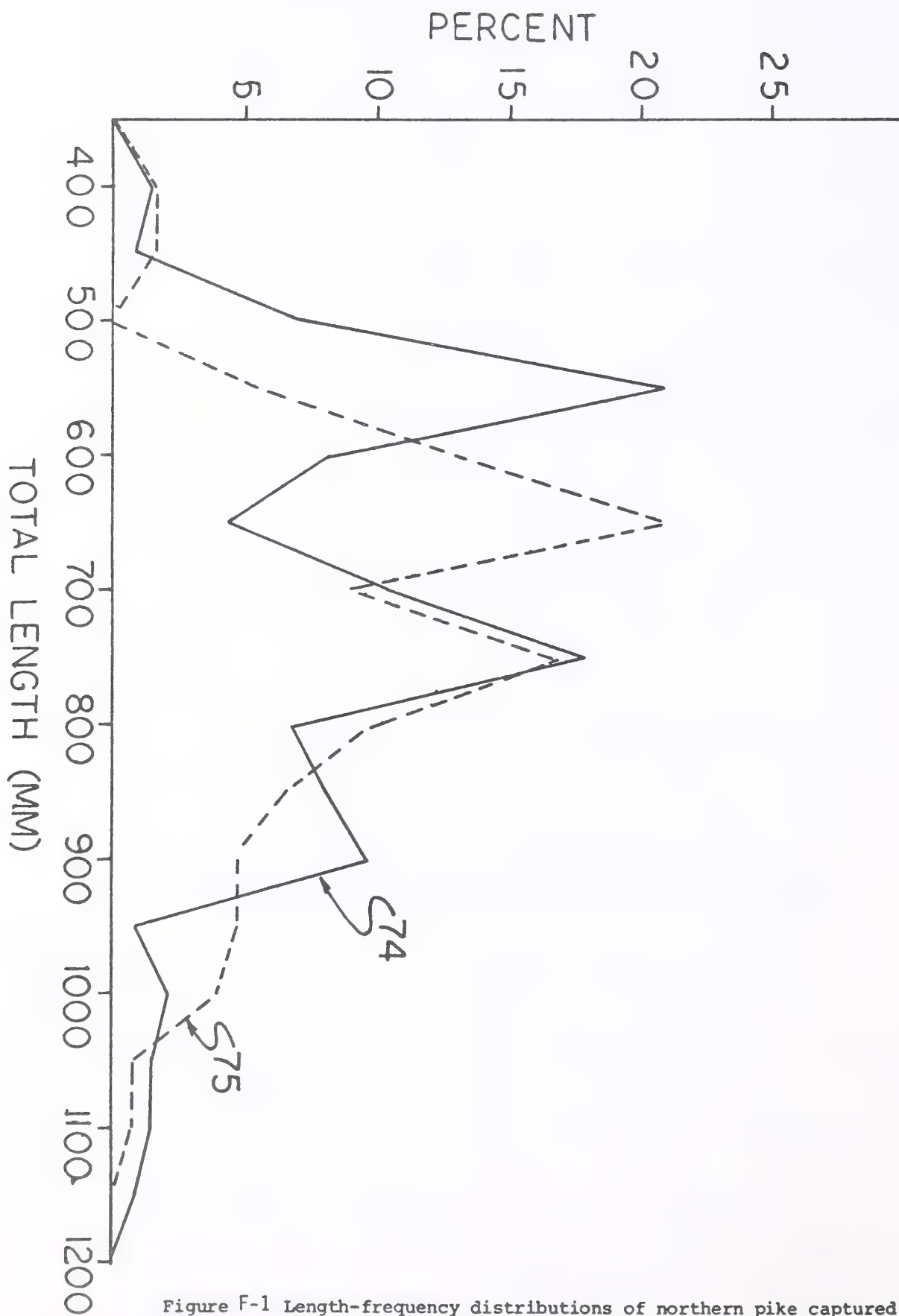


Figure F-1 Length-frequency distributions of northern pike captured in trap nets, Tongue River Reservoir, 1974-1975, expressed as percent of each size interval in the samples.

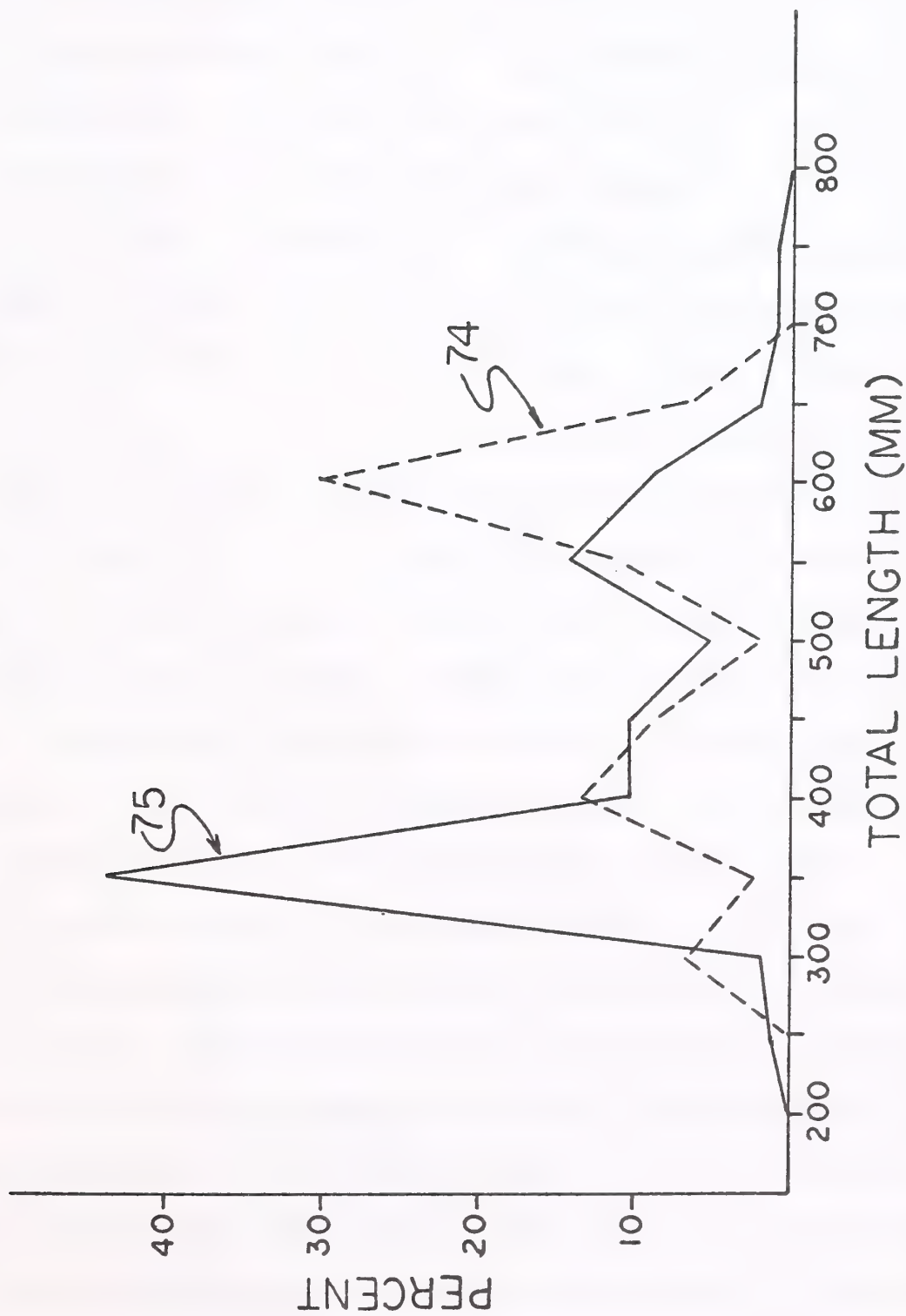


Figure F-2 Length-frequency distribution of walleye pike taken in trap nets, Tongue River Reservoir, 1974-1975, expressed as percent of each size interval in the sample.

percent). Northerns ranged in length from 400 to 1,150 mm in 1974 and from 400 to 1,100 mm in 1975. The length frequency distribution of northern pike caught in traps reveals distinct age groups in the spawning population (Figure 2). The fingerling northerns planted in 1972 matured in 1974 with a length interval of 450-650 mm. This age class increased in 1975 to a length interval of 500-700 mm. The average weight northerns was similar in 1972 and 1973 (3,746 grams and 3,750 grams, respectively), but declined in 1974 as the younger fish entered the spawning population. The average weight showed an increase in 1975. Apparently survival of the 1973 plant was not as high as the 1972 plant since size class is not shown in the length-frequency diagram. The lack of this size class also suggests limited natural reproduction.

The walleye catch was distributed about equally between Zones A and B, contributing 40.7 and 41.7 percent, respectively. The remaining 18.2 percent were captured in Zone C. Zones A and B represent the best walleye spawning areas with rocky shoal areas. Over 70 percent (66 of 91) of the walleyes were taken during April with May and June being represented equally (18 of 91). Walleyes ranged in length from 305 to 799 mm in 1974 with the size interval of 575 to 624 mm comprising 31.1 percent (Figure F-2). In 1975, walleyes ranged from 269-813 mm with the size interval of 375-424 mm contributing 43.9 percent. The inclusion of young walleye into the spawning population indicates that walleye are spawning. Average weights of walleye also show the inclusion of younger fish into the run in 1975. The average weight declines from 1,507 grams in 1974 to 1,217 grams in 1975. Scale samples taken during the spawning season showed these fish to be IV+ years old. Storage patterns for 1971 reveal good water levels during April which enhanced the walleye production.

White and black crappie were the dominant fish in the sample, contributing 65.5 and 8.9 percent of the sample, respectively. Both species were taken in greater numbers during June, with 8.13 percent of the white crappie and 60.1 percent of the black crappie taken during the month. Less than 5 percent of the catch of both species was taken during April. Crappie showed differential distribution patterns in the reservoir, with 58.7 percent of the blacks being caught in Zone C. The remainder of the black crappie were about equally split between Zones A (15.8 percent) and B (17.3 percent). White crappie were most abundant in Zone B (77.4 percent), followed by Zone A (14.7 percent). Only 7.8 percent of the whites were captured in Zone C. The distribution pattern is probably the result of differential water quality between the upper and lower ends of the reservoir and reflects habitat preferences of the two crappie species (Brown, 1971).

Length frequency distribution of black and white crappie for 1975 is shown in Figure F-3. Black crappie show a greater distribution of lengths, ranging from 100-499 mm, while white crappie ranged from 100-399 mm. Black crappie produce larger fish, with specimens to 1,362 grams common. For white crappie, the size interval of 225-274 mm was dominant, contributing 80.4 percent of the total, while black crappie showed a greater width for the dominant size class, 175-299 mm making up 82.4 percent.

Population estimates were computed for the dominant sport fishes taken in the trap nets (Table 24). Estimates of northern pike greater than 275 mm in length were 272 in 1974 and 228 in 1975. Based on the average weight of trap netted fish, northern pike standing crop was 0.564 kg per ha in 1974 and 0.496 kg per ha in 1975. Estimates of standing crops of northern pike in Wisconsin lakes ranged from 0.673 kg per ha (Snow and Beard, 1972); and in a southern Michigan lake ranged from 3.5 to 5.3 kg per ha (Schneider

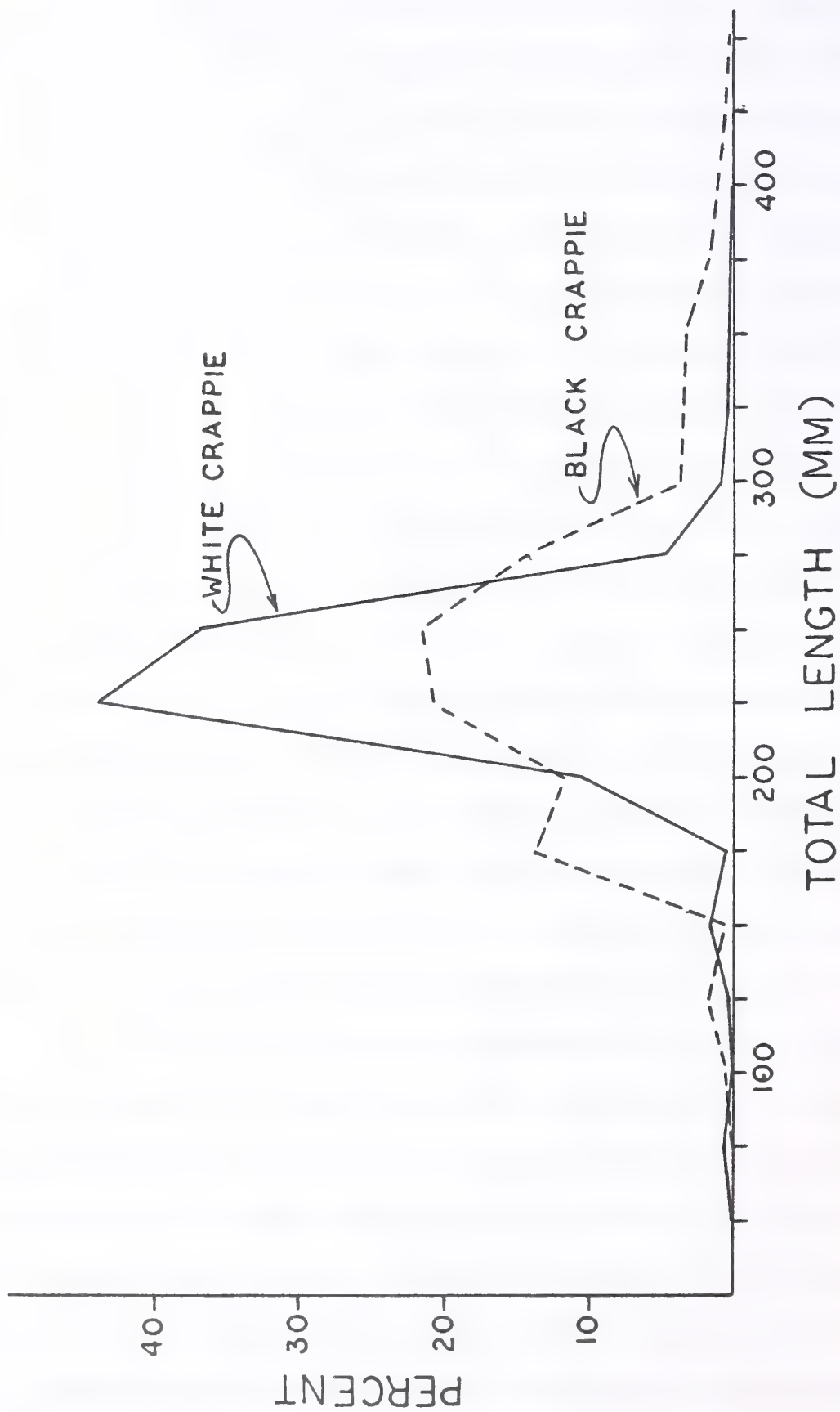


Figure F-3.-Length-frequency distribution of black (dashed line) and white (solid line) crappie taken in trap nets, Tongue River Reservoir, 1975, expressed as percent of each size interval in the samples.

1971). Thus apparently the population of northern pike in the reservoir is comparatively low, probably as a result of lack of natural reproduction.

The total crappie estimate for 1975 was 46,613 fish, with whites contributing 44,087 (31.1 per ha), and blacks 2,526 (1.78 per ha). Estimates of standing crop were 6.227 kg per ha for white crappie and 0.535 kg per ha for black crappie. The population strength of crappie in the Tongue River Reservoir appears to be comparable to those found in other area. Populations of black crappie in several Michigan lakes ranged from 1 to 96 fish per hectare (Schneider 1971).

The total trap net catch was greatest in Zone B, contributing 60.1 percent of the total. Crappie accounted for over 88 percent of the Zone B catch. June produced the greatest catch rate with 63.2 percent of the fish taken that month.

Gill netting

Fish population trends were observed with the aid of gill nets fished during July. A total of 18 experimental gill nets were fished on the bottom for a 24-hour period. Gill net catches for the years 1964 through 1975 are summarized in Table 25.

A total of 21 species of fish representing eight families have been caught in the reservoir. Total catch per net night ranged from a low of 27.6 in 1971 to a high of 74.8 in 1964. The mean catch rate was 44.9 fish per night. White crappie dominated the catch seven out of the ten sampling periods. Shorthead redhorse dominated two years and black bullheads the remaining year.

White crappie dominated the 1975 catch, contributing 30.7 percent of the total catch, followed by shorthead redhorse (23.4 percent) and yellow bullheads (13.5 percent). Game fish made up 10.6 percent of the total,

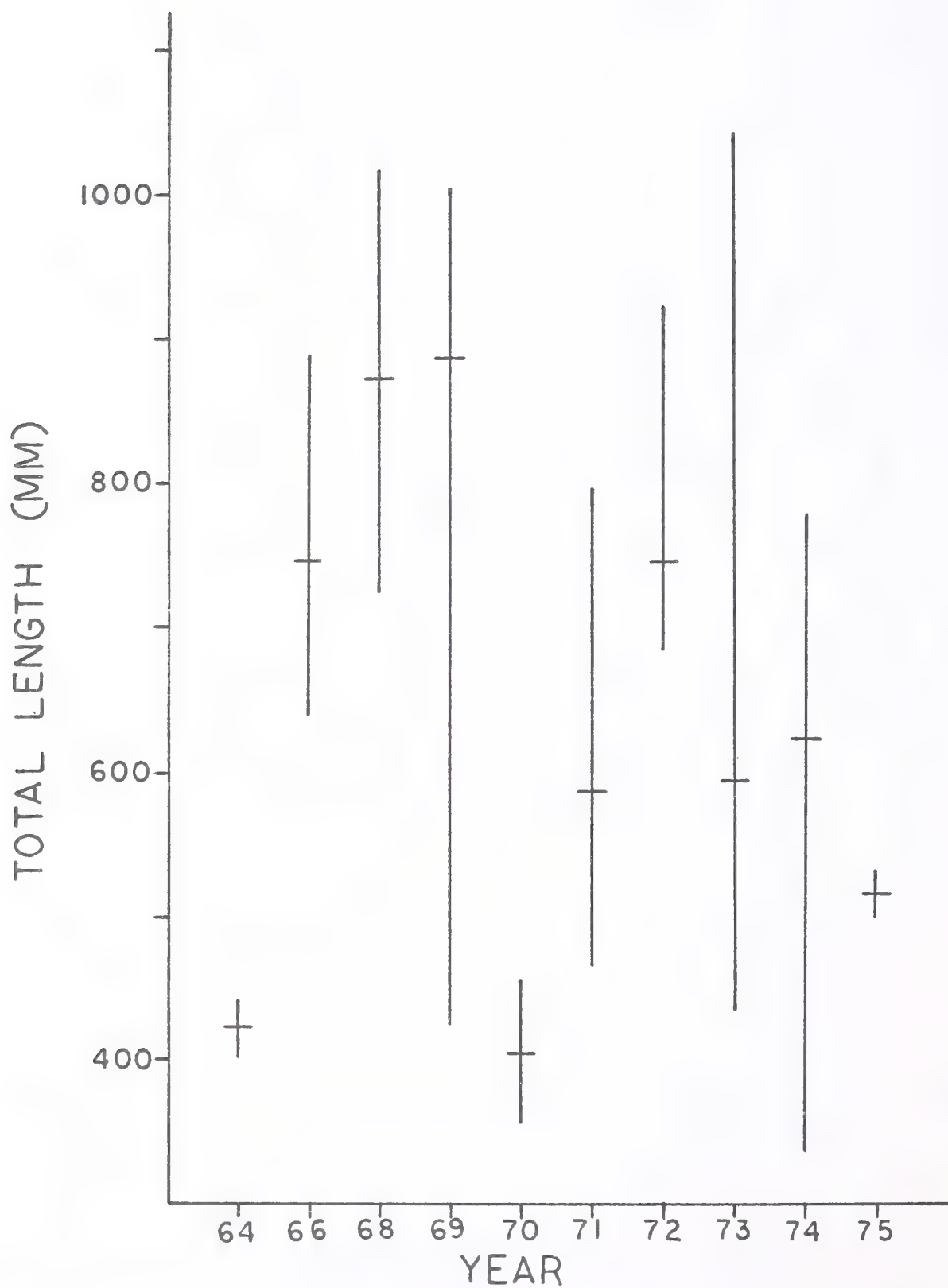


Figure F-4. Average length (horizontal line) and range (vertical line) of northern pike from gill net catches, Tongue River Reservoir, 1964-1975.

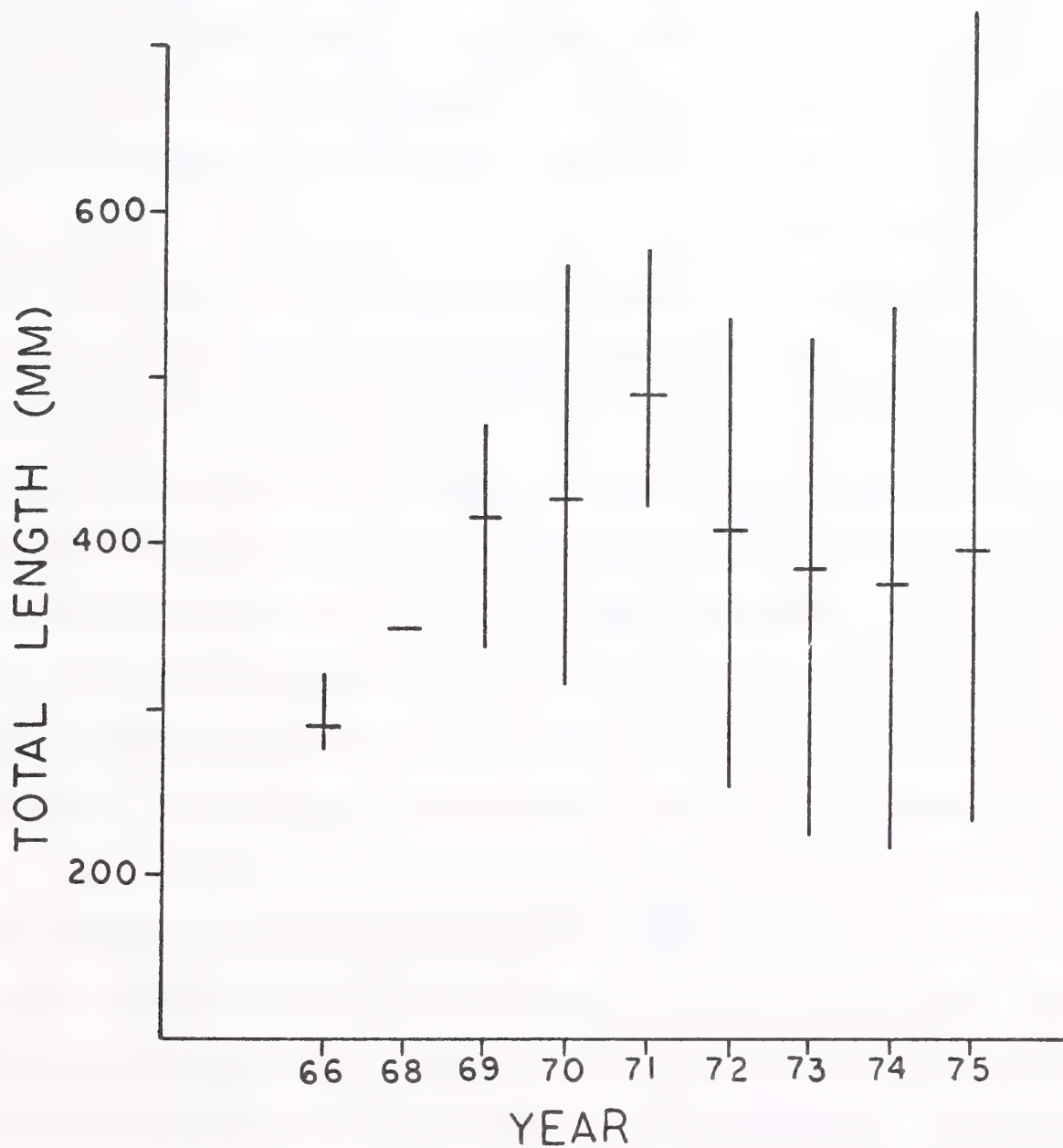


Figure F-5. Average length (horizontal line) and range (vertical line) of walleye pike from gill net catches, Tongue River Reservoir, 1966-1975.

which is comparable to the game fish catch of 1974 (10.1 percent).

Northern pike numbers declined while sauger and walleye increased. The average length of northern pike for the years 1964-1975 shows great variation (Figure F-4). The increased size from 1964-1969 followed by a great reduction which stabilized adds support that northerns are not reproducing successfully in the reservoir. Walleye increased in size from 1966 to 1971, followed by a stabilized level (Figure F-5). The inclusion of smaller fish beginning in 1972 reveals that walleye are successfully reproducing in the reservoir.

Smallmouth bass were captured in the reservoir for the first time in 1972 and sauger in 1973. Montana has stocked smallmouth bass in the river downstream from the dam, but no records exist for stocking in the reservoir. Correspondence with the Wyoming Game and Fish Department revealed that smallmouth bass had been stocked in strip mined ponds adjacent to the Tongue River near Sheridan. High water during the runoff period apparently flowed into the reservoir. Smallmouth are becoming a favorite target of anglers fishing the reservoir. Sauger were transplanted by Wyoming into the lower Tongue River and are now becoming well established in the reservoir.

Seining

Shoreline seining has been conducted during August and September to evaluate reproductive success in the reservoir. Catch rates for 1972, 1973, 1974, and 1975 were 24.2, 81.7, 238.0, and 100.00 fish per seine haul, respectively. Largemouth bass contributed 17.1 fish per haul in 1974 and 5.3 per haul in 1975. Smallmouth bass added 4.3 per haul and 6.2 per haul, respectively. Seine hauls produced catch rates of largemouth bass by zone as follows: A, 0.7; B, 1.8; C, 10.5 per haul, while smallmouth catch rates were: A, 0.1; B, 7.3, and C, 7.3 per haul, respectively.

Age and growth

Scale samples were taken from the major sport fishes, for analysis of age and growth, but have not been examined.

Tagging

Numbered Floy (FD-67) anchor tags were placed in a total of 500 sport fish to evaluate growth rates, movement and relative fishermen harvest (Table 8). One-hundred-fifty-eight (37.3 percent) tagged fish have been taken in subsequent years during the spring trapping season. Northern pike returns averaged 58.0 percent (130 returns out of 224 tagged fish). In 1975, 174 northernns were captured, of which 89 (52.0 percent) were tag returns, suggesting that a high percentage of the northern population is tagged.

Anglers have returned 5.3 percent of the northern pike tagged during 1974 and 1975. Walleye returns for the two year period was 1.6 percent. The small rate of tag returns suggests harvests well within tolerable limits of fish populations.

Creel census methods

A partial creel census designed to sample anglers as they left the reservoir was conducted in 1975 and 1976. A creel census station was established on the main access road to the reservoir and was operated from 10:00 A.M. until dark or until all fishermen had left the reservoir. The station was operated in 1975 on subsequent days during the week (i.e. Monday one week; Tuesday the next week, etc.), and alternate weekend days. In 1976, the fishing season was stratified by two-week periods with two week days and two weekend days randomly selected for each strata. Data was recorded on creel census forms and transferred to computer cards for analysis. The results of the census are given on page 311.

Fishery studies of the Tongue River above the reservoir

A 2.5 mile section of the Tongue River upstream from the reservoir was electrofished in September 1975. The section was sampled to evaluate species composition and distribution above the reservoir. A total of 322 fish were captured, representing 14 species. Shorthead redhorse predominated, making up 31.4 percent of the total, followed by carp 30.4 percent. Sauger and smallmouth bass were the only game fish taken. The presence of young-of-the-year sauger indicates that this species is reproducing in the river.

Discussion

The objective of the Tongue River Reservoir segment of this study is to obtain baseline information of the fish populations of the reservoir and to document angler use and harvest rates. Decker Coal Company plans to expand mining operations in the near future to include the east side of the reservoir. Questions raised concerning high sodium levels in the soils of the area make it important to evaluate current fish population levels in the reservoir. Fish populations data will be coordinated with information collected by a detailed limnology study of the reservoir. This information will make possible the evaluation of the effects of a strip mine in close proximity to a reservoir. Research needs include emphasis on the walleye-sauger population, life history information on black and white crappie, and food habits of major sport fishes.

APPENDIX G

SOCIOECONOMICS

APPENDIX G
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SOCIOECONOMICS

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Population

Development assumptions (Fitzpatrick, 1975)

- a. Population change is the product of birth, death, and migration.

The components of population change are influenced by a multitude of variables ranging from disease, famine, and war to religious attitudes, educational background, and political oppression. The nature of a local economy, be it one of development and growth, stagnation, or decline, is one variable which will effect population change.

- b. Economic development (i.e., the proposed Decker mines) is considered a major impetus for population change.

Economic development is described here as the construction and operation of the proposed East and North Extension mines. The tie between economic development and population change is made through employment. The mines provide jobs which attract workers and their families to the area (or hold individuals who might otherwise be out-migrants).

- c. Estimates of population change attributable to the Decker mine proposals consider both the direct and indirect employment effects of the mines.

The direct impact of the mines is seen in the creation of jobs in mine construction and operation. Coal transport by rail also adds employment. Mine and rail jobs are considered basic employment.¹ The indirect influence of the mines is seen in the stimulation of the local

1

Basic employment is described as employment in the production of goods or services for sale to consumers or producers outside the base or local economy. Basic activities are considered as bringing new money into the local economy. Secondary or derived employment is described as employment in the production of goods and services for local consumption. (e.g., barbers, grocery clerks, cooks, dentists, etc.) In theory income generated by the basic sector stimulates or sustains the derived sector of a local economy. The general relationship between basic and derived activities is described by a multiplier.

economy. Additional basic employment creates an increasing demand for locally produced goods and services. Employment in this sphere is termed secondary or derived. Estimates of future population extend from projected employment increases in mine operations and construction, railroads, and the derived sector.²

- d. Mine work and railroad employment is considered the basic component of the local economy. All other jobs are considered derived.

The estimated number of mine construction, mine operation, railroad, and derived employees is included in table 47.

- e. All basic jobs (i.e. mine and railroad) are filled by immigrating workers.

By assuming in-migration to all basic jobs, it is tacitly assumed that the impact area lacks sufficient reserves of skilled industrial manpower. The impact area has a small population. The area's existing economic base is strongly oriented toward agriculture, commerce, services, and government. The area lacks a large industrial base. It is not un-

2

Caution must be used in attempting to measure population change using estimates of new derivative employment. The relationship between basic and derived employment. The relationship between basic and derived employment is complex. The creation of X number of new basic jobs does not axiomatically lead to Y number of new derived jobs. This point is frequently overlooked, and the basic/derived employment relationship (i.e., the employment multiplier) is often misused. Even when derived employment can be predicted with some degree of certainty that same certainty cannot be translated into calculations of population change. A time lag can often be anticipated between a change in basic employment and a concomitant change in the derived sphere. A local labor market may contain some slack (i.e., excess capacity) with existing services able to meet the needs of changing population levels. Derived employment is diverse in nature. The concept commonly includes occupations such as physicians, attorneys, teachers, chambermaids, bank tellers, gas station attendants, grocery store clerks, etc. Some of these positions can be expected to be filled by in-migrants. Others will be filled by the existing population (e.g., working wives, part-time student help, people holding second jobs, etc.). Derived employment does not lead to automatic changes in population levels.

reasonable to assume that workers with "industrial" skills would be in short supply. In this respect, the impact area would not differ from other rural locations beset with industrialization.³

This assumption is made with the full recognition that some mine workers could and probably would be existing residents of the impact area. It is also recognized that a job training program could increase the supply of native labor available for mine work.

- f. Derived jobs are filled by in-migrating workers and females. Women employees participate in the labor force as derived workers. Forty percent (40%) of the married workers are female. Estimation procedures consider households and single individuals as input variables. Married women are a component of households. Calculation of the "derived population" requires subtraction of the number of married, female workers from total full-time derivative employment.

This assumption is made to avoid the methodological flaw of assuming that all new derivative workers are in-migrants. It is not the case. Female participation in the labor force is principally in the "derivative sector." These workers are drawn, in part, from the indigenous population. The assumption that 40% of the married derivative work force is female is based upon estimates and interpolations of national and state information regarding female labor force participation rates.⁴

- g. The migrant population attracted to the impact area will illustrate slightly different population characteristics when compared with the existing population.

3

Somers, Gerald. "Labor Recruitment in a Depressed Rural Area". Monthly Labor Review, October 1958; Gray, Irwin. "Employment Effects of a New Industry in a Rural Area", Monthly Labor Review, June 1969; Peterson, John M. and Wright, Earl. Dynamics of Small Area Labor Supply: A Case Study, Industrial Research and Extension Center, Little Rock; 1967.

⁴U.S., Department of Labor, Manpower Administration. Manpower Report to the President 1975. Government Printing Office; Washington, D.C., 1975.

The salient differences appear to be or include:

- (1) In-migrants are assumed to be between the ages of 18 and 65 years (i.e., working age).
- (2) The median age of the migrant population is assumed to be at or near the national median age of 28.1 years. This age suggests a population somewhat older than Big Horn and Rosebud county populations but significantly younger than Sheridan county.
- (3) Given the relative age of the in-migrants, it is further assumed that a higher proportion will be married.
- (4) All in-migrants are assumed to be Caucasian.
In this respect, the in-migrants are viewed as being racially similar to the existing population of Sheridan county but dissimilar with that of Big Horn and Rosebud counties.
- (5) Racial and age differences between migrants and residents implies differing family size. Young, white migrants will have larger families than the existing old, white residents of Sheridan county. The migrant families will not be as large as those found in Big Horn and Rosebud counties where the population is young and contains a large segment of Indians.

- h. Fifty percent (50%) of the in-migrating construction workers will be married with 1.5 children per married couple. Eighty percent (80%) of the in-migrating operational mine workers, railroad, and derivative employees will be married with 1.5 children per married couple.

Estimates of 1.5 children per married couple and proportions of 50% and 80% married were utilized in demographic analyses conducted at Colstrip, Montana.⁵ These assumptions do not appear unreasonable when marriage, family size, and age data are considered for each county. The Decker Coal Company, in recent survey of its employees, has indicated an average of 1.2 - 1.5 children per family.⁶

- i. Each married couple will have 1.125 school aged children.

This assumption is relatively standard in marking 25% of all children as being under the age of 6 years.

- j. The in-migrating population will be distributed in a manner similar to the existing work force and population associated with the Decker Coal Company. That is, 90% of the in-migrants will settle in Sheridan County. The majority of these people will settle in the city of Sheridan. The remaining population (10%) is attributed to Big Horn County.

This assumption largely concurs with the output of the VTN gravity model.⁷ Given the existing transportation network and availability of services, Sheridan (city) is the most likely center of settlement.

5

Jobes, Patrick C. Population Projections and Estimates of Rosebud and Contiguous Counties Associated with Coal Development and the Potential Construction of Colstrip Generating Plant #3 and #4. Bozeman, Montana; August 1974.

6

Mr. Bob Clark, Environmental Coordinator, Decker Coal Company, telephone conversation August 25, 1975. The Decker estimate of family size is based upon an incomplete tabulation of survey questionnaires. It is considered a preliminary estimate subject to revision.

7

VTN Colorado, Draft Environmental Impact Assessment for the Proposed East Decker Coal Mine. 1975.

Predicting the settlement patterns of new residents is difficult since new subdivisions or settlements may spring up outside the immediate Sheridan area. If this were to be the case, it is possible that areas beyond Sheridan would experience greater levels of population change.

- k. No other coal or industrial development will occur within the impact area boundaries (especially in the vicinity of Sheridan).

This assumption may appear somewhat naive given the presence of large stripable deposits of coal in Montana and Wyoming. Texaco, Shell, and others⁸ are actively examining development prospects in the Sheridan area. However, in the absence of a definitive statement of intent (e.g., an application for a surface mine permit), no provision is made to include employment or population data from tentative or speculative projects.

- l. With the exception of in-migration associated with the proposed Decker mine expansion, net migration is assumed to be zero in Big Horn and Sheridan Counties. Rosebud County will not experience population change attributable to the proposed Decker projects. For all counties, natural increase is assumed constant at 1970-1974 levels.

⁸ Montana Energy Advisory Council, Coal Development Information Packet. Helena, Montana; December 1974.

TABLE G-1

POPULATION CHARACTERISTICS - BIRTHS AND DEATHS^{1/}

| | 1970 Birth Rate ^{2/} | 1974 Birth Rate | Number of Births 1970-1974 | 1970 Death Rate | 1974 Death Rate | Number of Births 1970-1974 | 1970-1974 ^{3/} Natural Increase (Number) (Percent) |
|----------------------|-------------------------------------|-----------------------|-------------------------------|-----------------------|-----------------------|-------------------------------|-------------------------------------------------------------------|
| Big Horn (county) | 24.8 | 22.0 | 1,143 | 9.6 | 10.2 | 500 | 643 6.5 |
| Rosebud (county) | 27.5 | 24.9 | 839 | 13.4 | 10.4 | 376 | 463 7.8 |
| Sheridan (county) | 13.4 | 13.7 | 1,276 | 15.2 | 12.8 | 1,259 | 17 0.2 |
| Montana (state) | 18.2 | 16.7 | 60,078 | 9.5 | 8.9 | 33,774 | 26,304 3.8 |
| Wyoming (state) | 19.7 | 17.5 | 31,075 | 8.8 | 8.6 | 15,146 | 15,929 4.9 |

^{1/} Montana, Department of Health and Environmental Sciences, Bureau of Records and Statistics, Montana Vital Statistics. Helena, Montana, 1970-1973.

Wyoming, Department of Health and Social Services, Vital Records Services. (unpublished records and statistics, 1970-1974).

^{2/} Rates are calculated as the number of births or deaths per 1,000 population.

^{3/} Natural Increase is the excess of births over deaths. Percent calculations are derived from the 1970 base population.

TABLE G-2

POPULATION CHARACTERISTICS - SEX AND RACE^{1/}

| | 1970 Sex Ratio ^{2/} | 1970 White Population | Percent White | 1970 Indian Population | Percent Indian | Total Population |
|----------------------|---------------------------------|--------------------------|------------------|---------------------------|--------------------|---------------------|
| Big Horn (county) | 98 | 6,018 | 59.8% | 3,917 | 38.9% | 10,057 |
| Rosebud (county) | 102 | 4,203 | 69.7% | 1,820 | 30.2% | 6,032 |
| Sheridan (county) | 99 | 17,662 | 98.9% | 100 ^{3/} | 0.6% ^{3/} | 17,852 |
| Montana (state) | 100 | 663,043 | 95.5% | 27,130 | 3.9% | 694,409 |
| Wyoming (state) | 101 | 323,024 | 97.2% | 4,980 | 1.5% | 332,416 |

^{1/} Sources: U.S., Bureau of the Census, U.S. Census of Population: 1970 General Population Characteristics, Final Report PC (1) - B28 Montana. Government Printing Office, Washington, D.C.; 1970.

U.S., Bureau of the Census, U.S. Census of Population; 1970 Characteristics of the Population vol. 1, part 52 Wyoming. Government Printing Office, Washington, D.C.; 1970.

^{2/} The sex ratio is the number of males per every 100 females

^{3/} Estimated

TABLE G-3

POPULATION CHARACTERISTICS - MARITAL STATUS AND HOUSEHOLDS^{1/}

| | 1970 Number Married (14 years and older) | Percent Married | 1970 Number of Households | 1970 Persons Per Household | 1970 ^{2/} County Rank (persons per household) | 1970 Number of Children ^{3/} per Married couple |
|----------------------|------------------------------------------------|--------------------|---------------------------------|----------------------------------|--------------------------------------------------------------|----------------------------------------------------------------|
| Big Horn (county) | 4,266 | 63.8% | 2,664 | 3.74 | 1st of 56 | 2.07 |
| Rosebud (county) | 2,637 | 63.4% | 1,817 | 3.24 | 13th of 56 | 1.88 |
| Sheridan (county) | 8,712 | 62.5% | 6,189 | 2.78 | 22nd of 23 | 1.34 |
| Montana (state) | 318,460 | 63.4% | 217,304 | 3.10 | NA | NA |
| Wyoming (state) | 159,504 | 66.2% | 104,600 | 3.09 | NA | NA |

^{1/} Sources: U.S., Bureau of the Census, U.S. Census of Population: 1970 General Population Characteristics, Final Report PC (1) - B28 Montana. Government Printing Office, Washington, D.C.; 1970.

U.S., Bureau of the Census, U.S. Census of Population: 1970 Characteristics of the Population vol. 1, part 52 Wyoming. Government Printing Office, Washington, D.C.; 1970.

^{2/} Counties are ranked from high to low. The county with the highest number of persons per household receives the rank of one (1), etc. Rank ordering is based on intra-state comparisons. Montana has 56 counties; Wyoming has 23 counties.

^{3/} Estimated.

TABLE G-4

POPULATION CHARACTERISTICS - AGE^{1/}

| | Less than 18 years (percent) | 18-64 years (percent) | 65 years or more (percent) | Median Age (years) | Median Age ^{2/} (rank among counties) |
|----------------------|---------------------------------|--------------------------|-------------------------------|-----------------------|---------------------------------------------------|
| Big Horn (county) | 42.1% | 51.0% | 6.9% | 23.4 | 55th of 56 |
| Rosebud (county) | 39.6% | 50.2% | 10.2% | 26.2 | 43rd of 56 |
| Sheridan (county) | 30.7% | 53.4% | 15.9% | 36.8 | 2nd of 23 |
| Montana (state) | 36.5% | 53.6% | 9.9% | 27.1 | NA |
| Wyoming (state) | 36.1% | 54.8% | 9.1% | 27.2 | NA |

^{1/} Sources: U.S., Bureau of the Census, U.S. Census of Population: 1970 General Population Characteristics, Final Report PC (1) - B28 Montana. Government Printing Office, Washington, D.C.; 1970.

U.S., Bureau of the Census, U.S. Census of Population: 1970 Characteristics of the Population vol. 1, part 52 Wyoming. Government Printing Office, Washington, D.C.; 1970.

^{2/} Counties are ranked from high to low median age. The county with the highest median age receives the rank of one (1), etc. Rank ordering is based on intra-state comparisons. Montana has 56 counties; Wyoming has 23 counties.

Economics (Polzin, 1975)

Inventory of economic conditions

Overview of the impact area and its economic base

The three-county impact area may be characterized as a sparsely populated region whose economy has been oriented toward agriculture. With the exception of the City of Sheridan, the area has been predominately a rural, agricultural region with livestock grazing on the extensive grassland ranges as the primary economic base. The City of Sheridan has developed primarily as a trade center serving the surrounding ranching community.

Agriculture

Farms and ranches play a crucial role in the economy of the rural portions of the study area. From table G-5, it can be seen that 90 percent of the land in the study area was devoted to farms and ranches in 1969--significantly higher than the statewide averages for Montana and Wyoming. Since the Census of Agriculture for 1974 will not be available for at least another year, 1969 represents the latest year for which this type of information is available.

There were 1,427 farms and ranches in the impact area in 1969, with an average size of 5,108 acres, ranging from 7,598 acres in Rosebud County to a low of 3,036 acres in Sheridan County. The average farm or ranch in the impact area was almost twice as large as the statewide average for Montana and 27 percent more than the corresponding figure for Wyoming. Table G-5 also shows that the value of land and buildings per farm or ranch is higher in the impact area than either Montana or Wyoming, probably due to the larger ranch sizes. Only 8 percent of the land in farms and ranches was devoted to cropland; indicating the area's relative specialization in livestock grazing. About 2 percent of the area's farm and ranch land was irrigated in 1969, ranging from a little over 1 percent in Rosebud County to 4 percent in Sheridan County.

About 80 percent of the cash receipts from farm marketings in the area are from livestock sales, and the remaining 20 percent are from sales of crops. The average net income per farm or ranch in the impact area was \$15,857, or \$2.18 per acre during 1969 (table G-6).

Table G-5

Selected Characteristics of Farms and Ranches
in the Impact Area, Montana, and Wyoming
1969

| | Big Horn County | Rosebud County | Sheridan County | Impact Area | Montana | Wyoming |
|-----------------------------------------------|-----------------|----------------|-----------------|---------------|-----------------|-----------------|
| Land area in farms and ranches (acres) | 2,816,994 | 2,963,025 | 1,508,873 | 7,288,892 | 62,918,247 | 35,476,374 |
| Percentage of total land area | 87.6 | 91.9 | 93.1 | 90.4 | 67.5 | 57.0 |
| Number of farms and ranches | 540 | 390 | 497 | 1,427 | 24,951 | 8,838 |
| Average size (acres) | 5,217 | 7,598 | 3,036 | 5,108 | 2,522 | 4,014 |
| Value of land and buildings | \$136,581,000 | \$83,685,000 | \$91,006,525 | \$311,273,952 | \$3,748,207,000 | \$1,445,269,986 |
| Per farm | \$252,928 | \$214,576 | \$183,111 | \$218,132 | \$150,222 | \$163,529 |
| Per acre | \$48.48 | \$28.24 | \$60.31 | \$42.71 | \$59.57 | \$40.73 |
| Cropland (acres) | 294,794 | 148,158 | 118,491 | 561,443 | 16,108,575 | 2,788,453 |
| Percentage of total land in farms and ranches | 10.5 | 5.0 | 7.9 | 7.7 | 25.6 | 7.9 |
| Irrigated land (acres) | 48,400 | 34,993 | 60,801 | 144,194 | 1,841,421 | 1,523,422 |
| Percentage of total land in farms and ranches | 1.7 | 1.2 | 4.0 | 2.0 | 2.9 | 4.3 |

Sources: U.S. Bureau of the Census, Census of Agriculture: 1969, *Area Reports, Montana*, vol. 1, pt. 38, sec. 2 (Washington, D.C.: U.S. Government Printing Office, 1972), table 1, pp. 1, 17, and 353; and idem, Census of Agriculture: 1969, *Area Reports, Wyoming*, vol. 1, pt. 40, sec. 2 (Washington, D.C.: U.S. Government Printing Office, 1972), table 1, pp. 1 and 137. Percentages derived.

Table G-6

Agricultural Receipts and Income in the
Impact Area
1970 and 1972

| | <u>1970</u> | <u>1972</u> |
|--------------------------------------------|--------------|--------------|
| Total gross agricultural income | \$61,600,000 | \$76,425,000 |
| Average per farm | 43,167 | NA |
| Average per acre | 8.45 | NA |
| Cash receipts from farm marketings | 48,533,000 | 68,407,000 |
| Livestock | 38,651,000 | 55,531,000 |
| Crops | 9,882,000 | 12,876,000 |
| Government payments | 3,324,000 | 2,516,000 |
| Nonmoney income | 9,743,000 | 5,502,000 |
| Total net agricultural income ^a | 22,628,000 | 27,683,000 |
| Average per farm | 15,857 | NA |
| Average per acre | 2.18 | NA |

Sources: U.S. Bureau of Economic Analysis, Regional Economics Information System, unpublished data (Washington, D.C., November 1974). Averages per farm and per acre for 1970 were derived using data on the number of farms and acres in 1969 as reported in U.S. Bureau of the Census, *Census of Agriculture: 1969, Area Reports, Montana*, vol. 1, pt. 38, sec. 2 (Washington, D.C.: U.S. Government Printing Office, 1972), table 1, pp. 1, 17, and 353; and idem, *Census of Agriculture: 1969, Area Reports, Wyoming*, vol. 1, pt. 40, sec. 2 (Washington, D.C.: U.S. Government Printing Office, 1972), table 1, pp. 1 and 137.

NA denotes that the figures are not available; in this case, the averages per farm and acre could not be derived because data on the number of farms and acres are not available for 1972.

^aAdjusted for net change in inventories.

In summary, farms and ranches in the impact area may be characterized as large, efficient, and relatively profitable. They have specialized in livestock production, which makes the best use of the vast tracts of range-land; although crops do provide a significant source of revenue.

Mining

The major mineral, in terms of economic value to the impact area, is coal. Mining of the area's vast coal resource has only begun in earnest in recent years. All but one of the following, currently producing, surface coal mines began operations after 1967:

| <u>Mine Operator</u> | <u>Location</u> | <u>Year Started</u> | <u>Estimated 1975 Production (Tons/Year)</u> |
|------------------------------------|-----------------|---------------------|------------------------------------------------------|
| Peabody Coal (Big Sky Mine) | Rosebud County | 1968 | 3,000,000 |
| Western Energy (Rosebud Mine) | Rosebud County | 1968 | 5,230,000 |
| Westmoreland (Sarpy Creek Mine) | Big Horn County | 1974 | 4,000,000 |
| Decker Coal (West Decker Mine) | Big Horn County | 1972 | 8,250,000 |
| Big Horn Coal (Big Horn Mine) | Sheridan County | 1940's | 1,000,000 |

Only a small fraction of the study area's coal has been recovered, leaving a substantial resource base for coal-related development in the future.

Strip mining is a capital intensive industry requiring relatively few workers per mine, but the workers are well paid, averaging about \$16,000 per year using 1974 wage scales.

Labor Force

In 1970, the U. S. Bureau of the Census reported 12,620 persons in the impact area's civilian labor force (table G-7). Over 55 percent of this total resided in Sheridan County and 65 percent were males.

Table G-7

Civilian Labor Force and Unemployment, by Sex
Big Horn and Rosebud Counties, Montana
and Sheridan County, Wyoming
1970

| | <u>Male</u> | <u>Female</u> | <u>Total</u> |
|---------------------------|-------------|---------------|--------------|
| Impact area | | | |
| Civilian labor force | 8,147 | 4,473 | 12,620 |
| <i>Percent unemployed</i> | 4.6 | 4.1 | 4.4 |
| Big Horn County | | | |
| Civilian labor force | 2,332 | 985 | 3,317 |
| <i>Percent unemployed</i> | 4.9 | 4.0 | 4.6 |
| Rosebud County | | | |
| Civilian labor force | 1,505 | 841 | 2,346 |
| <i>Percent unemployed</i> | 4.6 | 4.6 | 4.6 |
| Sheridan County | | | |
| Civilian labor force | 4,310 | 2,647 | 6,957 |
| <i>Percent unemployed</i> | 4.4 | 3.9 | 4.2 |

Sources: U. S. Bureau of the Census, Census of Population: 1970, *General Social and Economic Characteristics, Montana*, PC(1)-C28 (Washington, D.C.: U. S. Government Printing Office, 1971), table 121, pp. 28-206 and 28-209; and idem, Census of Population: 1970, *General Social and Economic Characteristics, Wyoming*, PC(1)-C52 (Washington, D. C.: U. S. Government Printing Office, 1971), table 121, p. 52-151.

Unemployment averaged 4.4 percent of the civilian labor force in the study area as of April 1970 and was relatively uniform throughout the area. The countywide data, however, do not reveal the high unemployment rate among Indians. The Bureau of the Census reported that unemployment on the Northern Cheyenne Indian Reservation was 11.1 percent in 1970 and 11.6 percent on the Crow Indian Reservation.¹ Even this dismal picture of employment opportunities on the reservation may be too rosy. The census definition of the unemployed includes those who were without a job but looking for work.² This excludes persons who would like to work but were not actively seeking work at the time of the census--sometimes called "disguised unemployment." The U. S. Bureau of Indian Affairs estimates that many Crow and Northern Cheyenne Indians fall into this category and that, if they had been included, the unemployment rate would have been between 25 and 30 percent of the labor force.³ Disguised unemployment is not limited to Indians. The labor force participation rates for most age-sex groups in the impact area counties were below the corresponding statewide figures.⁴ (The use of individual age-sex groups corrects for the

¹U. S. Bureau of the Census, U. S. Census of Population: 1970, *Subject Reports, American Indians*, Final Report PC(2)-1F (Washington, D.C.: U. S. Government Printing Office, 1973), table 13, pp. 161 and 162.

²U. S. Bureau of the Census, U. S. Census of Population: 1970, *Characteristics of the Population, Montana*, vol. 1, pt. 28 (Washington, D.C.: U. S. Government Printing Office, 1972), Appendix B, p. App-20.

³U. S. Department of the Interior, Bureau of Indian Affairs, "Indians in the Northern Great Plains: Anticipated Socio-Economic Impacts of Coal Development," prepared for the Socio-Economic Work Group of the Northern Great Plains Resources Program, mimeographed (Billings, Montana, n.d.), table 4, p. 7.

⁴U. S. Bureau of the Census, Census of Population: 1970, *General Social and Economic Characteristics*, Final Reports PC(1)-C52, Wyoming, and PC(1)-C28, Montana (Washington, D.C.: U.S. Government Printing Office, 1971), tables 46 and 121.

potential bias due to the larger proportion of older persons living in the Sheridan area.) Disguised unemployment appears to be greatest for females and young persons.

Employment and Earnings

Employment patterns in the study area are substantially different from those in Montana or Wyoming as a whole. Agriculture, retail trade, services, and welfare, religious and nonprofit organizations accounted for 58 percent of the employment in the study area in 1970 as compared to 50 percent in Montana and only 46 percent in Wyoming (table G-8). The study area had noticeably lower employment in mining (these figures are for 1970, before coal production reached its current levels); construction; transportation, communication, and public utilities, wholesale trade, and finance, insurance and real estate.

A closer look at the county detail in table G-8 reveals some major differences among the counties. Big Horn and Rosebud Counties had a relatively greater orientation toward agriculture; it accounted for 26 percent of the employment in those counties during 1970, compared to only 12 percent in Sheridan County. Employment in welfare, religious, and nonprofit organizations was 6 percent of the total in Big Horn and Rosebud Counties, reflecting government and private Indian service agency employment on or near the Crow and Northern Cheyenne Indian Reservation; the comparable figures for Sheridan County was 2 percent of total employment.

The distribution of employment in Sheridan County, on the other hand, indicates its importance as a regional trade center. Over 45 percent of the employment in Sheridan County was devoted to retail trade and to providing business, personal, health and professional services.

Table G-8

Civilian Employed Persons by Major Industry Group
Big Horn and Rosebud Counties, Montana and
Sheridan County, Wyoming
1970

| | ----- Civilian Employed Persons ----- | | | --- Percentage of Total --- | | |
|----------------------------------------------------------|---------------------------------------|-------------------|--------------------|-----------------------------|---------|---------|
| | Big Horn County | Rosebud County | Sheridan County | Impact Area | Montana | Wyoming |
| Agriculture, forestry, and fisheries | 885 | 511 | 798 | 2,194 | 18.2 | 13.4 |
| Mining | -- | 63 | 182 | 245 | 2.0 | 2.4 |
| Construction | 162 | 117 | 430 | 709 | 5.9 | 6.4 |
| Manufacturing | 317 | 174 | 300 | 791 | 6.6 | 9.7 |
| Transportation, communication, and public utilities | 132 | 151 | 455 | 738 | 6.1 | 8.0 |
| Wholesale trade | 35 | 6 | 177 | 218 | 1.8 | 3.8 |
| Retail trade | 509 | 309 | 1,395 | 2,213 | 18.3 | 18.5 |
| Finance, insurance, and real estate | 62 | 53 | 214 | 329 | 2.7 | 3.9 |
| Business, personal, health, and professional services | 309 | 208 | 1,645 | 2,162 | 17.9 | 16.1 |
| Education and public administration | 655 | 437 | 929 | 2,021 | 16.8 | 16.2 |
| Welfare, religious, and nonprofit organizations | 97 | 209 | 138 | 444 | 3.7 | 1.8 |
| All employed persons | 3,163 | 2,238 | 6,663 | 12,064 | 100.0 | 100.0 |

Sources: U.S. Bureau of the Census, Census of Population: 1970, *General Social and Economic Characteristics, Montana*, PC(1)-C28 (Washington, D.C.: U.S. Government Printing Office, 1971), table 55, p. 28-129, table 123, pp. 28-216 and 28-219; and *Idem*, U.S. Census of Population: 1970, *General Social and Economic Characteristics, Wyoming*, PC(1)-C52 (Washington, D.C.: U.S. Government Printing Office, 1971), table 55, p. 52-96, and table 123, p. 52-155. Percentages derived.

Notes: The data pertain to persons sixteen years of age and older who are in the civilian labor force.

Percentage detail may not add to total because of rounding.

This compares with only 25 percent in Big Horn and Rosebud Counties combined.

The occupations of workers (table G-9) also reflect the differences in the industrial structure in the study area as compared to the states of Montana and Wyoming. There are significantly greater proportions of farm and service workers and smaller proportions of sales workers and operatives in the impact area than in Montana and Wyoming as a whole.

Table G-10 presents the available data for earnings by occupation in 1969 for the study area. The median earnings for males shows wide differences among occupations, with laborers and farm workers at the bottom of the scale and professional and managerial workers earning the most. The earnings of females, concentrated in clerical and operative jobs, were substantially lower than for males. Lower female earnings probably reflect not only lower wage scales, but also shorter work weeks and fewer weeks worked during the year. The median earnings for most of the occupations tend to be higher in Sheridan County than in Big Horn or Rosebud Counties, but, with the exception of farmers and farm laborers, lower than the statewide figures for Montana and Wyoming.

Income

Total personal income in the impact area grew from \$111,149,000 in 1969 to \$171,088,000 in 1973, an increase of almost 54 percent (table G-11). The increases in Big Horn and Rosebud Counties were 75 and 85 percent, respectively, with much of this rise due to the prosperous conditions in agriculture during the latter part of this period. Total personal income in Sheridan County by comparison, increased only 36 percent from 1969 to 1973.

Table G-9

Civilian Employed Persons, by Occupation
Big Horn and Rosebud Counties, Montana
and Sheridan County, Wyoming
1970

| | ----- Civilian Employed Persons ----- | | | -- Percentage of Total -- | | |
|------------------------------------------------------|---------------------------------------|-------------------|--------------------|---------------------------|---------|---------|
| | Big Horn County | Rosebud County | Sheridan County | Impact Area | Montana | Wyoming |
| Professional, technical, and kindred workers | 432 | 234 | 1,078 | 1,744 | 14.5 | 15.2 |
| Managers and administrators, except farm managers | 302 | 204 | 698 | 1,204 | 10.0 | 11.0 |
| Sales workers | 130 | 57 | 394 | 581 | 4.8 | 5.4 |
| Clerical and kindred workers | 358 | 304 | 1,093 | 1,755 | 14.5 | 14.7 |
| Craftsmen, foremen, and kindred workers | 305 | 184 | 691 | 1,180 | 9.8 | 13.7 |
| Operatives, except transport | 184 | 151 | 360 | 695 | 5.8 | 8.5 |
| Transport equipment operatives | 81 | 67 | 222 | 370 | 3.1 | 3.8 |
| Laborers, except farm | 135 | 141 | 276 | 552 | 4.6 | 4.3 |
| Farmers and farm managers | 554 | 306 | 360 | 1,220 | 10.1 | 5.5 |
| Farm laborers and farm foremen | 298 | 191 | 309 | 798 | 6.6 | 3.5 |
| Service workers, except private household | 375 | 386 | 1,020 | 1,781 | 14.8 | 12.9 |
| Private household workers | 9 | 13 | 162 | 184 | 1.5 | 1.4 |
| All employed persons | 3,163 | 2,238 | 6,663 | 12,064 | 100.0 | 100.0 |

Sources: U.S. Bureau of the Census, Census of Population: 1970, *General Social and Economic Characteristics, Montana*, PC(1)-C28 (Washington, D.C.: U.S. Government Printing Office, 1971), table 54, p. 28-127, table 122, pp. 28-111 and 28-214; and idem, Census of Population: 1970, *Social and Economic Characteristics, Wyoming*, PC(1)-C52 (Washington, D.C.: U.S. Government Printing Office, 1971), table 54, p. 52-94, and table 122, p. 52-153. Percentages derived.

Notes: The data pertain to persons sixteen years of age and older who are in the civilian labor force.

Percentage detail may not add to totals because of rounding.

Table G-10

Median Earnings of Males and Females by Occupational Group
in Big Horn, Rosebud, and Sheridan Counties
Montana and Wyoming
1969

| | <u>Big Horn</u> | <u>Rosebud</u> | <u>Sheridan</u> | <u>Montana</u> | <u>Wyoming</u> |
|------------------------------------------------|-----------------|----------------|-----------------|----------------|----------------|
| <u>Males</u> | | | | | |
| Professional, managerial, and kindred workers | \$7,663 | \$7,364 | \$9,615 | \$9,088 | \$9,672 |
| Craftsmen, foremen and kindred workers | 6,536 | 6,129 | 6,700 | 7,588 | 7,942 |
| Operatives, including transport | 3,686 | 6,394 | 6,500 | 6,732 | 7,141 |
| Laborers, except farm | 4,188 | 5,071 | 4,245 | 5,092 | 4,725 |
| Farmers and farm managers | 4,571 | 2,383 | 6,175 | 5,627 | 5,694 |
| Farm laborers, except unpaid, and farm foremen | 2,451 | 3,682 | 3,674 | 2,802 | 3,565 |
| <u>Females</u> | | | | | |
| Clerical and kindred workers | 3,207 | 3,127 | 3,217 | 3,382 | 3,422 |
| Operatives, including transport | 2,528 | 3,000 | 2,111 | 2,395 | 2,094 |

Sources: U.S. Bureau of the Census, Census of Population: 1970, *General Social and Economic Characteristics, Montana*, PC(1)-C28 (Washington, D.C.: U.S. Government Printing Office, 1971), table 57, p. 28-133, table 122, pp. 28-211 and 28-214; and idem, Census of Population: 1970, *General Social and Economic Characteristics, Wyoming*, PC(1)-C52 (Washington, D.C.: U.S. Government Printing Office, 1971), table 57, p. 52-100, and table 122, p. 52-153.

Note: The data are for persons sixteen years of age and older with earnings who are in the experienced labor force.

Table G-11

Total and Per Capita Personal Income by Place of Residence
Big Horn and Rosebud Counties, Montana
and Sheridan County, Wyoming
1969-1973

| | <u>1969</u> | <u>1970</u> | <u>1971</u> | <u>1972</u> | <u>1973</u> | <u>Percent Change 1969-1973</u> |
|-----------------------------------------------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------------|
| <u>Total Personal Income (Thousands of Dollars)</u> | | | | | | |
| Total, impact area | \$111,149 | \$127,761 | \$134,055 | \$150,340 | \$171,088 | 53.9 |
| Big Horn County | 27,726 | 31,071 | 31,400 | 40,150 | 48,578 | 75.2 |
| Rosebud County | 17,772 | 20,845 | 22,586 | 26,069 | 32,875 | 85.0 |
| Sheridan County | 65,651 | 75,845 | 80,069 | 84,121 | 89,635 | 36.5 |
| <u>Per Capita Personal Income (Dollars)</u> | | | | | | |
| Total, impact area | \$ 3,269 | \$ 3,747 | \$ 3,920 | \$ 4,308 | \$ 4,675 | 43.0 |
| Big Horn County | 2,758 | 3,074 | 3,106 | 3,898 | 4,550 | 65.0 |
| Rosebud County | 2,932 | 3,438 | 3,699 | 4,073 | 4,724 | 61.1 |
| Sheridan County | 3,697 | 4,228 | 4,460 | 4,622 | 4,748 | 28.4 |
| Montana | 3,174 | 3,498 | 3,575 | 4,083 | 4,626 | 45.7 |
| Wyoming | 3,417 | 3,814 | 3,865 | 4,268 | 4,696 | 37.4 |

Source: U.S. Bureau of Economic Analysis, Regional Economics Information System, unpublished data (Washington, D.C., August 1975). Percentages derived.

Per capita personal income is the most widely used indicator of economic well-being. It is not a perfect index because it equates well-being with money income and certainly the residents of this area enjoy considerable benefits which are not easily measured in terms of dollars. Money income, nevertheless, is the one measure which is readily available and easily understood. Average per capita income in the study area during 1973 was \$4,675, approximately equal to the state-wide figures for Montana and Wyoming, \$4,626 and \$4,696, respectively. Within the impact area, Big Horn County residents consistently had the lowest average income. Sheridan County, on the other hand, has consistently had the highest level of per capita income; but, its rate of growth between 1969 and 1973 lagged behind the Montana counties because it is relatively less dependent on agriculture.

The importance of the recent prosperity in agriculture to the rapid growth of income in the impact area is shown in table G-12, which delineates the major components of personal income. Notice that, for the impact area as a whole, farm proprietors' income grew by about 127 percent. It is debatable, however, whether or not this prosperity will continue. The price of beef has been declining and the plight of cattle ranchers has received wide attention. Total nonfarm proprietors' income actually decreased by 7 percent, with only Rosebud County experiencing a slight increase. Wage and salary disbursements, the largest component of personal income, increased by 44 percent from \$53,687,000 in 1969 to \$77,255,000 in 1973.

It is interesting to note the higher proportion of nonparticipation income in Sheridan County than in Big Horn or Rosebud Counties. Nonparticipation income includes dividends, interest, rents and transfer

Table G-12

Personal Income by Type in the Impact Area
Big Horn and Rosebud Counties, Montana
and Sheridan County, Wyoming
1969 and 1973

(Thousands of Dollars)

| Type of Income | Big Horn County | | | Rosebud County | | | Sheridan County | | | Impact Area | | |
|----------------------------------|-----------------|----------|-------------------|----------------|----------|-------------------|-----------------|----------|-------------------|-------------|----------|-------------------|
| | 1969 | 1973 | Percent Change | 1969 | 1973 | Percent Change | 1969 | 1973 | Percent Change | 1969 | 1973 | Percent Change |
| Wage and salary disbursements | \$12,297 | \$18,980 | 54.3 | \$8,705 | \$16,340 | 87.7 | \$32,685 | \$41,935 | 28.3 | \$53,687 | \$77,255 | 43.9 |
| Other labor income | 550 | 1,053 | 91.5 | 510 | 1,251 | 145.3 | 1,369 | 2,028 | 48.1 | 2,429 | 4,332 | 78.3 |
| Proprietors' income | 10,118 | 22,168 | 119.1 | 5,297 | 11,846 | 123.6 | 8,483 | 8,804 | 3.8 | 23,898 | 42,818 | 79.2 |
| Farm | 8,607 | 20,678 | 140.2 | 4,138 | 10,624 | 156.7 | 2,674 | 3,638 | 36.1 | 15,419 | 34,940 | 126.6 |
| Nonfarm | 1,511 | 1,490 | -1.4 | 1,159 | 1,222 | 5.4 | 5,809 | 5,166 | -11.1 | 8,479 | 7,878 | -7.1 |
| Dividends, interest, and rent | 3,154 | 3,482 | 10.4 | 2,517 | 2,932 | 16.5 | 16,290 | 25,309 | 55.4 | 21,961 | 31,723 | 44.5 |
| Transfer payments | 2,506 | 4,245 | 69.4 | 1,911 | 2,923 | 53.0 | 7,980 | 13,417 | 68.1 | 12,397 | 20,585 | 66.0 |

Source: U.S. Bureau of Economic Analysis, Regional Economics Information System, unpublished data (Washington, D.C., August 1975). Percentages derived.

payments, such as Social Security payments, pensions, and government assistance. In 1973 about 42 percent of the personal income in Sheridan County is attributable to passive income sources as compared to 11 percent in Big Horn County and 12 percent in Rosebud County. The higher dependence on passive income sources in Sheridan County is probably closely related to the significant number of older people in the county, many of whom are living on retirement and investment incomes.

Labor and proprietors' income, often called participation income, are presented by industry source in table G-13 for 1973. The industry figures emphasize the dependence of Big Horn and Rosebud Counties on agricultural income, which comprised 55 percent and 40 percent of total participation income in those counties, respectively. Sheridan County received most of its participation income in 1973 from wholesale and retail trade, services, and government, which taken together, accounted for 59 percent of the total. For the impact area as a whole, farm, trade, service, and government incomes provided 74 percent of the total labor and proprietors' income in 1973.

Poverty is a problem in the study area. Based on a federal inter-agency committee definition of poverty, which takes into account such factors as family size, sex and age of the family head, number of children, and farm-nonfarm residence, over 18 percent of the residents of the area had incomes below the poverty level in 1969 (table G-13). That figure, which includes members of families and unrelated persons, compares with statewide averages of 14 percent for Montana and 12 percent for Wyoming. Poverty rates were higher for families in Big Horn and Rosebud Counties, but Sheridan County had a higher percentage of unrelated

TABLE G-13

Labor and Proprietors' Income, by Industry
Big Horn and Rosebud Counties, Montana
and Sheridan County, Wyoming
1973

| Industry | (Thousands of Dollars) | | | |
|--------------------------------------------------------|------------------------|-------------------|--------------------|---------------------|
| | Big Horn County | Rosebud County | Sheridan County | Impact Area |
| Farm | \$23,081 | \$12,006 | \$ 5,341 | \$40,428 |
| Nonfarm | 19,120 | 17,431 | 47,426 | 83,977 |
| Private | 11,712 | 13,816 | 32,056 | 57,584 |
| Manufacturing | 822 | 1,069 | 3,432 | 5,323 |
| Mining | (D) | (D) | 1,121 | 7,501 ^a |
| Contract construction | 1,742 | 969 | 5,704 | 8,415 |
| Wholesale and retail trade | 3,019 | 1,707 | 9,695 | 14,421 |
| Finance, insurance, and real estate | 639 | 348 | 2,423 | 3,410 |
| Transportation, communication, and public utilities | 922 | 2,287 | 2,804 | 6,013 |
| Services | 2,403 | (D) | 6,242 | 11,269 ^a |
| Other industries | (D) | 178 | 635 | 1,232 ^a |
| Government | 7,408 | 3,615 | 15,370 | 26,393 |
| Federal, civilian | 4,127 | 1,424 | 6,511 | 12,062 |
| Federal, military | 185 | 118 | 521 | 824 |
| State and local | 3,096 | 2,073 | 8,338 | 13,507 |

Source: U.S. Bureau of Economic Analysis, Regional Economics Information System, unpublished data
(Washington, D.C., August 1975).

(D) Not shown to avoid disclosure of confidential information or for items \$50,000 or less.

^aEstimated.

Table G-14

Poverty Status of Residents, Big Horn and Rosebud Counties, Montana
 Sheridan County, Wyoming, Crow Indian Reservation
 and Northern Cheyenne Indian Reservation
 1969

| | Residents Below Poverty Level | | | Percentage of Total ^a | | |
|--------------------------------------|-------------------------------|------------------------------------|--------------------------|----------------------------------|-----------------------|-------------|
| | Families | Unrelated Individuals ^b | All Persons ^c | Families | Unrelated Individuals | All Persons |
| Impact area | 1,218 | 1,093 | 6,219 | 14.3 | 38.8 | 18.3 |
| Big Horn County | 474 | 189 | 2,522 | 21.4 | 33.3 | 25.3 |
| Rosebud County | 301 | 176 | 1,519 | 20.0 | 35.2 | 25.8 |
| Sheridan County | 443 | 728 | 2,178 | 9.3 | 43.1 | 12.7 |
| Crow Indian Reservation | 184 | 40 | 1,348 | 40.0 | 85.1 | 44.7 |
| Northern Cheyenne Indian Reservation | 175 | 29 | 916 | 39.8 | 78.4 | 40.7 |

Sources: U.S. Bureau of the Census, Census of Population: 1970, *General Social and Economic Characteristics, Montana*, PC(1)-C28 (Washington, D.C.: U.S. Government Printing Office, 1971), table 124, pp. 28-221 and 28-224; and idem, Census of Population: 1970, *General Social and Economic Characteristics, Wyoming*, PC(1)-C52 (Washington, D.C.: U.S. Government Printing Office, 1971), table 124, 52-157; and idem, Census of Population: 1970, *American Indians* PC(2)-1F (Washington, D.C.: U.S. Government Printing Office, 1973), table 14, pp. 171 and 172. All data for the impact area were derived.

Note: The poverty status is based on a federal interagency committee definition of poverty which takes into account such factors as family size, age, and sex of the family head, number of children, and farm-nonfarm residence.

^aNumber of residents (families, unrelated individuals, or all persons) below poverty level expressed as a percentage of all residents (families, unrelated individuals, or all persons) in the specific area.

^bAll persons in families and all unrelated individuals; i.e., the total population.

individuals with incomes below the poverty level. Again, this may reflect the large number of older persons, whose spouse may have died, living in the Sheridan area. The poverty rates for residents of the two Indian reservations were over twice the rates for the impact area as a whole, indicating that Indian poverty is a significant problem.

Government Expenditures and Revenues of Big Horn and Rosebud Counties

Expenditures and revenues for the two Montana counties in the impact area are presented in table G-15 and G-16. Data for fiscal years 1966 and 1974 are included and, even though particular years may have unusual expenditures or revenues, the general fiscal trend can be discerned from the data.

Expenditures for county purposes have been separated into five major functional categories and a miscellaneous, or non-allocable, category. Expenditures include operating costs of the county government plus capital outlays for buildings and equipment funded either from operating revenues, grants, or revenue sharing funds. In Big Horn County, total expenditures almost tripled during the period, from \$407,000 in 1966 to \$1,199,000 in 1974 (table G-15). General government expenditures climbed 108 percent from \$131,000 in 1966 to \$272,000 in 1974. Health and welfare increased 270 percent during the period, but a large portion of the expenditure in 1974 (\$177,000) was a capital outlay for hospital buildings and equipment. Although agriculturally related spending increased 212 percent, this category remained at about 2 percent of total county expenditures in both years. The slowest growing expenditure function was law enforcement which increased only 21 percent during the period. This is probably attributable to the fact that much of

Table G-15
Expenditures and Revenues in Big Horn County
Fiscal Years 1966 and 1975
(Current Dollars)

| | Fiscal Year 1966 (000) | Fiscal Year 1974 (000) | Percent Change 1966-1975 |
|--------------------------------------------------------|------------------------------|------------------------------|--------------------------------|
| Expenditures | | | |
| General government ^a | 131 | 272 | 107.6 |
| Roads and bridges ^b | 107 | 271 | 153.3 |
| Law enforcement ^c | 52 | 89 | 71.2 |
| Health and welfare ^d | 89 | 329 | 269.7 |
| Agricultural related ^e | 8 | 25 | 212.5 |
| Other, non-allocable ^f | 20 | 213 | 965.0 |
| Total expenditures for county purposes ^g | 407 | 1,199 | 194.6 |
| Revenues | | | |
| Taxes ^h | 328 | 688 | 109.8 |
| Other ⁱ | 133 | 505 | 279.7 |
| Total revenues ^j | 461 | 1,193 | 158.8 |

Sources: Big Horn County Clerk's Annual Reports to the State Examiner, fiscal years 1966 and 1974 (Hardin, Montana).

^aIncludes expenditures of commissioners, clerk, treasurer, assessor, classification and appraisal, surveyor, buildings, election, county planning, fairs, libraries, school superintendent, and airports.

^bIncludes highways, bridges, shop, new roads, tools and machinery.

^cIncludes district and justices' courts, attorney, sheriff, coroner, care of delinquent children, prisoners and jail.

^dIncludes ambulance, home demonstration agent, senior citizens, burial of soldiers, regional mental health, board of health, special hospital reimbursements to state welfare, county welfare administration, general relief, hospitals and poor fund.

^eIncludes predatory animal control, insect and weed control, agricultural agent.

^fIncludes refunds, city-county landfill, industrial accident insurance, PERS, and miscellaneous. In 1974, \$106,000 in revenue sharing funds are included.

^gDoes not include countywide support of education, except for expenditures of county superintendent's office.

^hIncludes all property taxes levied by the county government including the portion used to support schools.

ⁱIncludes refunds, interest, fees and charges, licenses and permits, fines and forfeitures, gifts and grants, revenue sharing, and miscellaneous income.

^jDoes not include trust and agency revenues collected for other levels of government.

Big Horn County is covered by the Crow and Northern Cheyenne Indian Reservations which have their own police forces and are not funded by the county. Part of the enormous increase in the non-allocable category, 965 percent, can be explained by noting the \$106,000 of revenue sharing funds expended by the county in 1974, but not reported by functional category.

The revenue data included for each county are not strictly comparable with the expenditure data for the same years because tax revenues of the counties include the portion collected and paid to school districts through the state equalization program but not recorded as an expenditure of the county.

The revenue data included in tables G-15 and G-16 does, however, indicate the trend in countywide tax collections during the period. Tax revenues in Big Horn County more than doubled, from \$328,000 in 1966 to \$688,000 in 1974. Other sources of revenue to the county, such as fines and forfeitures, refunds, interest, grants and revenue sharing funds increased even faster from \$133,000 to \$505,000, or 280 percent. Total county revenues increased 159 percent during the period from \$461,000 to \$1,193,000.

The figures for Rosebud County are presented in table G-16. Expenditures rose substantially in all of the categories with law enforcement and non-allocable expenditures posting the largest gains. The majority of the increase in law enforcement resulted from a large increase in expenditures for the Sheriff's Office. Total expenditures for the county increased from \$480,000 in 1966 to \$1,109,000 in 1974, an increase of 131 percent.

On the revenue side, taxes collected by Rosebud County increased

Table G-16
Expenditures and Revenues in Rosebud County
Fiscal Years 1966 and 1975
(Current Dollars)

| | Fiscal Year 1966 (000) | Fiscal Year 1974 (000) | Percent Change 1966-1975 |
|--------------------------------------------------------|------------------------------|------------------------------|--------------------------------|
| Expenditures | | | |
| General government ^a | 134 | 216 | 61.2 |
| Roads and bridges ^b | 147 | 296 | 101.4 |
| Law enforcement ^c | 48 | 218 | 354.2 |
| Health and welfare ^d | 63 | 103 | 63.5 |
| Agricultural related ^e | 39 | 92 | 135.9 |
| Other, non-allocable ^f | 49 | 184 | 275.5 |
| Total expenditures for county purposes ^g | 480 | 1,109 | 131.0 |
| Revenues | | | |
| Taxes ^h | 397 | 961 | 142.1 |
| Other ⁱ | 73 | 522 | 615.1 |
| Total revenues ^j | 470 | 1,483 | 215.5 |

Sources: Rosebud County Clerk's Annual Reports to the State Examiner, fiscal years 1966 and 1974 (Forsyth, Montana).

^aInclude expenditures of commissioners, clerk and recorder, treasurer, assessor, superintendent of schools plus elections, airport, reclassification (1966) vehicle disposal (1974) cemetery, museum, fair, civil defense, fire control, library, and county planning (1974).

^bIncludes county shops.

^cIncludes expenditures of district court, sheriff, county attorney, justices of the peace, coroner, juvenile office (1974) public administrator, crime commission (1974) and cost of care for prisoners.

^dIncludes expenditures for welfare, general relief, medical and hospital, burial of soldiers and senior citizens (1974).

^eIncludes soil conservation, rodent control, weed control, extension, migratory stock, coyote control, pest control, and state brand inspector (1974).

^fIncludes cost of county building maintenance, industrial accident, public employees' retirement system, social security.

^gDoes not include countywide support of education, except for expenditures of county superintendent's office.

^hIncludes all property taxes levied by the county government including the portion used to support schools.

ⁱIncludes refunds, interest, fees and charges, licenses and permits, fines and forfeitures, gifts and grants, revenue sharing, and miscellaneous income.

^jDoes not include trust and agency revenues collected for other levels of government.

142 percent from \$397,000 to \$911,000. However, other sources of revenue increased 615 percent from \$73,000 to \$522,000 largely as a result of revenue sharing and a grant for a hospital received in 1974. Total revenues of Rosebud County increased 216 percent from \$470,000 in 1966 to \$1,483,000 in 1974.

Expenditures and revenues for both counties increased dramatically from 1966 to 1975, but a large portion of the growth was due to the general rise in prices of the goods and services the counties purchased. If adjustment is made for the effect of inflation, Big Horn County's expenditures, in real terms, increased 77 percent over the nine years and Rosebud's spending increased only 39 percent.

Similar adjustments to the tax revenue figures show a real increase of 26 percent in tax collections for Big Horn County and 45 percent in Rosebud County over the period. Total revenues increased 55 percent, in real terms, in Big Horn County, and 89 percent in Rosebud County.

The property tax has historically been the major source of revenue for Montana local governments; but, as shown in tables G-15 and G-16, nontax sources of revenue have been increasing faster than property taxes. If this trend continues, there will be a decreasing reliance of the counties on the property tax.⁵ A major source of nontax revenue is the federal Revenue Sharing Program, which is funded by the federal government and subject to the usual uncertainties associated with Congressional action.

Property tax revenues depend on the taxable valuation of the jurisdiction and the mill levy rate. Table G-17 presents the taxable values

⁵Preliminary information from Rosebud County for fiscal 1975 indicates that nontax revenues exceeded property tax revenues for the year.

TABLE G-17

Taxable Valuation and Mill Levies for County Purposes and Countywide School Levies
Big Horn and Rosebud Counties
Fiscal 1966, 1970, 1974, and 1975

| | Property Other than Public Utilities | Local Property of Public Utilities | Public Utilities Allocated by Dept. of Revenue | Net Proceeds | Total Taxable Valuation | Mill Levy for County Purposes and Countywide School Levies |
|------------------------|--------------------------------------------|------------------------------------------|------------------------------------------------------|-----------------|-------------------------------|---------------------------------------------------------------------|
| Big Horn County | | | | | | |
| 1966 | \$10,084,641 | \$ 251,079 | \$2,195,986 | \$ 22,882 | \$12,554,588 | 67.89 |
| 1970 | 10,704,989 | 356,399 | 2,279,738 | 81,274 | 13,422,400 | 76.62 |
| 1974 | 12,776,499 | 390,053 | 2,126,674 | 526,231 | 15,819,457 | 95.86 |
| 1975 | 16,671,340 | 611,873 | 2,150,563 | 9,979,047 | 29,412,823 | 74.63 |
| Rosebud County | | | | | | |
| 1966 | 6,272,512 | 73,286 | 2,489,384 | 2,217,772 | 11,052,954 | 75.65 |
| 1970 | 7,337,474 | 95,741 | 2,380,931 | 745,284 | 10,599,430 | 95.29 |
| 1974 | 10,244,216 | 428,493 | 2,341,949 | 6,598,335 | 19,612,993 | 93.20 |
| 1975 | 13,145,212 | 3,671,729 | 2,205,543 | 6,643,812 | 25,666,296 | 82.18 |

Sources: State of Montana, Biennial Reports of the Montana State Board of Equalization for the Periods July 1, 1964 to June 30, 1966, and July 1, 1968 to June 30, 1970; and idem, State of Montana, Report of the State Department of Revenue for the Period July 1, 1972 to June 30, 1974 (Helena, Montana).

and mill levy rates for Big Horn and Rosebud Counties for several recent years. While taxable valuations in Big Horn County climbed gradually from 1966 to 1974 the mill levy increased about twice as fast, from 68 mills in 1966 to 96 mills in 1974, indicating that property owners were carrying a heavier property tax burden. The change in taxable value from 1974 to 1975 reflects the addition of coal mining properties to the tax roles and the huge jump in net proceeds (primarily from coal mines) taxes as property. As a result, Big Horn County reduced its mill levy rate from 96 mills in 1974 to 75 mills in 1975.⁶

A similar trend is evident in Rosebud County, except that coal properties and net proceeds began to affect the total taxable valuations in fiscal 1971, causing a corresponding decline in the mill levy from 95 mills in 1970 to 82 mills in 1975. A preliminary estimate of the taxable value for Rosebud County for 1976 is \$43,000,000 which will, no doubt, precipitate another decline in the mill levy rate.

The decreasing county reliance on property tax revenues, and the rapidly increasing taxable valuations resulting primarily from coal development appear to be reducing the property tax burden on taxpayers in the two counties, and will probably continue to do so as coal development in the area continues to expand.

Expenditures and Revenues of the City of Sheridan and Sheridan County

Trends in local government finances for the Wyoming portion of the impact area are analyzed using budgeted expenditures and expected

⁶A complete description of the Montana taxes associated with coal-related development is presented as a later section in Appendix G.

revenues for the City of Sheridan and Sheridan County during fiscal years 1966 and 1975. These figures should be interpreted with caution because they represent only anticipated expenditures and revenues. Further, the data for only two years may be distorted by isolated events or unusual expenditures. Nevertheless, if these shortcomings are kept in mind, these figures do provide a concise overview of local government conditions.

Budgeted expenditures and expected revenues for the City of Sheridan are presented in table G-18. The municipal Water and Sewer Department is itemized separately for both expenditures and revenues; it is self-financing and does not depend on taxes for operational revenue. The unusually large figure reported for fiscal 1966 was due to the expansion of the sewage treatment plant.

Total budgeted expenditures, excluding the Water and Sewer Department, grew from \$767,000 in fiscal 1966 to \$1,933,000 in fiscal 1975, an increase of about 152 percent. Expenditures from the General Fund, which account for most of the total, rose approximately 145 percent. Among the individual categories, the greatest increase was in Parks and Recreation, almost 942 percent; this does not appear to be an aberration, these expenditures increased sharply in 1972 and have remained at a high level. General government, the Police Department, and the Fire Department expenditures rose between 95 and 138 percent. Street and alley expenditures declined by about 32 percent, but there appears to be approximately \$150,000 in unusual expenditures--possibly construction--during fiscal 1966. Finally, the 1975 budgeted expenditures includes \$302,000 in federal revenue sharing projects.

On the revenue side, the largest increase was in transfers from

Table G-18
Budgeted Expenditures and Estimated Revenues
City of Sheridan, Wyoming
Fiscal Years 1966 and 1975
(Current Dollars)

| | Fiscal Year 1966 (000's) | Fiscal Year 1975 (000's) | Percent Change 1966-1975 |
|---------------------------------------|-----------------------------------|-----------------------------------|--------------------------------|
| Budgeted Expenditures | | | |
| General fund, total | \$ 710 | \$1,742 | 145.4 |
| General government ^a | 68 | 162 | 138.2 |
| Police department | 101 | 230 | 127.7 |
| Fire department | 87 | 170 | 95.4 |
| Streets and alleys | 301 | 205 | -31.9 |
| Public health and sanitation | 66 | 158 | 139.4 |
| Parks and recreation | 21 | 219 | 942.9 |
| Federal revenue sharing | -- | 302 | -- |
| All other | 66 | 296 | 348.5 |
| Bond sinking and interest funds | 57 | 167 | 193.0 |
| Cash and reserve funds | 0 | 24 | -- |
| Subtotal | \$ 767 | \$1,933 | 152.0 |
| Water and sewer | 2,233 | 653 | -70.8 |
| Total, budgeted expenditures | \$3,000 | \$2,586 | -13.8 |
| Estimated revenues | | | |
| Transfers from state ^b | \$ 119 | \$ 465 | 290.8 |
| Other nontax revenue ^c | 247 | 773 | 212.9 |
| Property taxes ^d | 167 | 218 | 30.5 |
| Cash available | 234 | 477 | 103.8 |
| Subtotal | \$ 767 | \$1,933 | 152.0 |
| Water and sewer revenue | 2,233 | 653 | -70.8 |
| Total, estimated revenue ^d | \$3,000 | \$2,586 | -13.8 |

Source: Budgets for the City of Sheridan.

^aIncludes general government, city attorney, city clerk and treasurer, cemetery, municipal court, engineering department.

^bFrom gas, sales, cigarette, and use (beginning in 1974) taxes.

^cIncludes federal revenue sharing during 1975.

^dExcludes Policemen Pension Fund.

Table G-19
Budgeted Expenditures and Estimated Revenues
Sheridan County, Wyoming
Fiscal Years 1966 and 1975
(Current Dollars)

| | Fiscal Year 1966 (000's) | Fiscal Year 1975 (000's) | Percent Change 1966-1975 |
|-----------------------------------------------------------|-----------------------------------|-----------------------------------|--------------------------------|
| Budgeted expenditures | | | |
| General Fund | \$ 363 | \$1,210 | 233.3 |
| General government ^a | 128 | 286 | 123.4 |
| Law enforcement and courts ^b | 84 | 176 | 109.5 |
| Roads and bridges | 95 | 208 | 118.9 |
| Federal revenue sharing | -- | 281 | -- |
| All other | 56 | 259 | 362.5 |
| Bond Sinking and Interest Funds | 35 | 41 | 17.1 |
| General Welfare and Health Funds | 93 | 68 | -26.9 |
| County Library Fund | 27 | 108 | 300.0 |
| County Fair Fund | 17 | 27 | 58.8 |
| General School Fund | -- | 92 | -- |
| Cash, depreciation, and Reserve Fund | -- | 81 | -- |
| Subtotal | \$ 535 | \$1,627 | 204.1 |
| County Hospital Fund | 781 | 2,078 | 166.1 |
| Total, all funds | \$1,316 | \$3,705 | 181.5 |
| Estimated revenue | | | |
| Transfers from state ^c | 69 | 260 | 276.8 |
| Cash available | 18 ^e | 188 | 944.4 |
| Other nontax revenue ^d (excluding hospital) | 116 | 669 | 476.7 |
| Property taxes (excluding hospital) | 332 | 510 | 53.6 |
| Subtotal | \$ 535 | \$1,627 | 204.1 |
| County Hospital, total | 781 | 2,078 | 166.1 |
| Estimated revenue | 733 | 2,025 | 176.3 |
| Property tax | 48 | 53 | 10.4 |
| Total, estimated revenue | \$1,316 | \$3,705 | 181.5 |

Source: Budgets for Sheridan County

^aIncludes county commissioners, clerk, treasurer, assessor, surveyor, coroner, water commissioner, health officer, and elections.

^bIncludes sheriff, clerk of court, justice court, courthouse, jail, and county attorney.

^cGas, sales, cigarettes, and use (beginning in 1974) taxes.

^dIncludes federal revenue sharing in 1975.

^eIncludes estimated cash on hand to reconcile Bond Sinking and Interest Funds

the state of Wyoming--the city's share of gas, sales, use, and cigarette taxes--which grew from \$119,000 in fiscal 1966 to \$465,000 in fiscal 1975, almost 291 percent. Other nontax revenue, which includes various fees and licenses plus federal revenue sharing in 1975, rose 213 percent. Finally, property tax payments were \$167,000 in fiscal 1966; by fiscal 1975, they had risen to \$218,000, or about 31 percent.

The figures for Sheridan County are shown in table G-19. Total county expenditures, excluding the County Hospital Fund, grew from \$535,000 in fiscal 1966 to \$1,627,000 in fiscal 1975, about 204 percent. The County Hospital is itemized separately because only a small portion of its revenue is derived from local taxes. Total General Fund expenditures rose 233 percent. Among the individual categories, general government, law enforcement, and roads and bridges grew between 110 percent and 123 percent.

Local property tax payments to Sheridan County, excluding the County Hospital Fund, increased about 54 percent, from \$332,000 to \$510,000, between fiscal 1966 and fiscal 1975. Transfers from the state of Wyoming and other nontax revenue grew by 277 and 477 percent, respectively.

The total expenditures of both the City of Sheridan and Sheridan County increased significantly between fiscal 1966 and fiscal 1975. Property tax payments grew, however, at a much slower rate. In fact, if allowances are made for the overall rise in prices during this period (real) property tax payments remained approximately constant or even declined slightly. To some extent, the expansion in local government expenditures was financed through the collection of fees, licenses, and other nontax revenue, and the federal revenue sharing program, which began

in fiscal 1973. But, the transfers of funds from the state of Wyoming to city and county governments was a mjaor reason for relatively slow growth in local property taxes. These payments consist of portions of the state sales and use taxes, the cigarette tax, and the gasoline tax which are apportioned out to the cities and counties in Wyoming. The current features of these programs are as follows:

Sales tax: The state of Wyoming has a three percent broadly based sales tax. Prior to 1975, one-sixth of the total sales tax collected in each county minus expenses for administration was distributed back to the county.⁷ Incorporated municipalities within the county receive a share of these funds equal to its proportion of the total county population as reported in the last federal census. The portion allocated to the county government is based on the percentage of the remaining population that is not included within the corporate limits of its cities and towns. These funds are allocated to the General Fund of the cities and counties. The 1975 Wyoming legislature raised the proportion distributed to cities and counties to one-third.⁸ During fiscal 1974, the City of Sheridan and Sheridan County received \$203,131 and \$116,981, respectively, in sales tax distributions. Counties in Wyoming may also impose an optional one percent sales tax if approved by the majority of its electors, which accrues entirely to the county government.⁹ Sheridan County has not approved this option.

Use tax: The use tax is three percent. It compliments the sales tax and is imposed on property brought into Wyoming from another state,

⁷Wyoming Department of Revenue and Taxation, *Annual Report, Fiscal Year 1974*, Cheyenne, 1974, p. A-11.

⁸Ibid., p. A-3.

⁹Ibid., p. A-3

and therefore not subject to Wyoming sales tax. Beginning in fiscal 1975, one-sixth of the use tax collections is distributed to municipalities in the same manner as provided for sales tax distribution using a percentage formula based on use tax collections to arrive at the amounts to be allocated to each county from out-of-state use tax collections.¹⁰ The estimated distribution for the City of Sheridan and Sheridan County is \$20,000 and \$2,500, respectively, for fiscal 1975.¹¹

Cigarette tax: Cigarette tax has been \$0.08 per pack since 1967.¹² The state of Wyoming receives three-eighths, minus administrative expenses, of the amount collected. The remainder is distributed to counties and incorporated cities and towns according to sales distributions reported by cigarette wholesalers.¹³ During fiscal 1974, the City of Sheridan and Sheridan County received \$123,000 and \$7,577, respectively, in cigarette tax distributions.¹⁴

Gasoline tax: The motor vehicle gasoline tax is \$0.07 per gallon. It is distributed among the state, counties, and cities in a complex manner.¹⁵ Most of the portion distributed to local governments is required to be used for the construction and maintenance of roads and highways. A tax on aviation gas is also imposed and distributed in roughly the same manner and is to be used for the maintenance of the

¹⁰Wyoming Department of Revenue and Taxation, *Annual Report, Fiscal Year 1974*, Cheyenne, 1974, p. 12.

¹¹Budgets for the City of Sheridan and Sheridan County.

¹²Wyoming Department of Revenue and Taxation, *Annual Report, Fiscal Year 1975*, p. A-5.

¹³Ibid., p. A-13.

¹⁴Ibid., p. A-37.

¹⁵Ibid., p. A-10.

airfields in the locality where it is collected. During fiscal 1975, the distribution for the City of Sheridan and Sheridan County is estimated to be \$92,000 and \$149,000, respectively.¹⁷

Projections of earnings and employment

The economy of the impact area may be conceptually divided into basic and derivative sectors. Basic industries are those which depend heavily on markets outside the area or are otherwise influenced by factors beyond its borders. Examples of basic industries are agriculture, railroads, the federal government, and, of course, mining. Derivative industries, on the other hand, principally serve the local population and include such businesses as wholesale and retail trade, services, and local government.

Economists believe that economic growth in small regions, such as the impact area, can be attributed to events outside the region and that changes in the basic industries will lead to further changes in the derivative industries. That is, basic industries sell their products outside the area or otherwise receive their funds from external sources. A significant portion of these "new" dollars are paid directly to workers in basic industries who, in turn, buy goods and services from local merchants. As these dollars are spent and respent within the local economy, they generate additional wages and salaries and may lead to new jobs in the derivative industries. The income expansion does not go on forever; sooner or later these dollars are spent for items not produced in the impact area and they exit from the local economy.

¹⁶Wyoming Department of Revenue and Taxation, Annual Report, Fiscal Year 1975, p. A-11.

¹⁷Budgets for the City of Sheridan and Sheridan County.

Table G-20

Basic Employment and Earnings, Proposed Decker Mines
Big Horn-Sheridan Impact Area
1976 to 2000

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> | <u>1985</u> | <u>2000</u> |
|-----------------------------------------------------|-----------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <u>North Extension Mine</u> | | | | | | | |
| Total earnings (thousands of 1970 dollars) | \$1,647 | \$1,054 | \$1,079 | \$1,104 | \$1,129 | \$1,269 | \$1,791 |
| Employment | | | | | | | |
| Total | 125 | 75 | 75 | 75 | 75 | 75 | 75 |
| Construction | 50 ^a | -- | -- | -- | -- | -- | -- |
| Operation | 70 | 70 | 70 | 70 | 70 | 70 | 70 |
| Railroad | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| <u>East Decker Mine</u> | | | | | | | |
| Total earnings (thousands of 1970 dollars) | \$2,033 | \$2,721 | \$4,003 | \$4,040 | \$4,465 | \$5,017 | \$7,083 |
| Employment | | | | | | | |
| Total | 165 | 215 | 285 | 275 | 297 | 297 | 297 |
| Construction | 165 | 215 | 65 | -- | -- | -- | -- |
| Operation | | | 200 | 250 | 270 | 270 | 270 |
| Railroad | | | 20 | 25 | 27 | 27 | 27 |
| <u>Total, North Extension and East Decker Mines</u> | | | | | | | |
| Total earnings (thousands of 1970 dollars) | \$3,680 | \$3,775 | \$5,082 | \$5,144 | \$5,594 | \$6,286 | \$8,874 |
| Employment | | | | | | | |
| Total | 290 | 290 | 360 | 350 | 372 | 372 | 372 |
| Construction | 215 | 215 | 65 | -- | -- | -- | -- |
| Operation | 70 | 70 | 270 | 320 | 340 | 340 | 340 |
| Railroad | 5 | 5 | 25 | 30 | 32 | 32 | 32 |

^aPrimarily heavy equipment operators and other workers needed to prepare site for mining.

The primary impact--the increased earnings and employment in the basic industries--of the proposed Decker mines is outlined in table G-20. Annual estimates of the number of permanent mine workers and construction employment were provided by the Decker Coal Company. The Burlington Northern Railroad estimates that, when at full production, the 12 million tons of coal to be mined annually will lead to about 32 new railroad jobs in the Sheridan area. This total was allocated between the two mines on the basis of permanent mine employment. Similarly, annual estimates of railroad employment before full production is reached is assumed to be proportional to the number of mine workers. Total basic earnings are presented in 1970 dollars to eliminate the effects of inflation. Current earnings per worker in each of the basic industries was estimated from information provided by the Decker Coal Company, the Burlington Northern Railroad, and the Montana Employment Security Commission. Future values were derived from national projections. The details of these calculations are presented in a later section of Appendix G.

The North Extension Mine is scheduled to begin production in 1976 with 70 mine workers and an estimated 5 railroad employees. In addition, there will be 50 heavy equipment operators and other workers needed to prepare the site for mining.¹ In 1977 and each year thereafter, permanent employment will number 75 workers, 70 in mine operation and 5 railroad employees. During 1976, the total earnings of construction workers, operation personnel, and railroad employees is projected to be \$1,647,000 (1970 dollars). In 1977, this figure will decline to \$1,054,000 (1970 dollars), due to the elimination of the site preparation jobs;

¹The Decker Coal Company believes that some of these workers may be transferred to permanent mine positions.

but each year thereafter total earnings are projected to increase because of the rise in the (real) earnings per worker.

The impact of the East Decker Mine, shown in table G-20, will begin with the employment of 165 construction workers in 1976. The construction work force will grow to 215 positions in 1977 and then decline to 65 positions in 1978. Coal production will commence in 1978 and 200 permanent jobs will be created. Mining employment will grow to 250 workers in 1979 and then peak at 270 positions in 1980 and each year thereafter. The corresponding railroad employment will be 20 workers in 1978, 25 workers in 1979, and 27 workers for the years 1980 to 2000. Total earnings of workers at the East Decker Mine is projected to increase from \$2,033,000 in 1976 (170 dollars) to \$4,465,000 (1970 dollars) in 1980 as the mine reaches full production. This figure is projected to increase further to \$7,083,000 (1970 dollars) by 2000 due to the rise in (real) earnings per worker.

Total earnings and employment for the North Extension and the East Decker Mines are summarized in the lower portion of table G-20. In 1976, a total of 290 new basic jobs will be created. This figure rises to 372 new basic jobs in 1980 and each year thereafter as construction ends and the mines reach full production. Total basic earnings are projected to be \$3,680,000 (1970 dollars) in 1976 and then to grow to \$5,594,000 (1970 dollars) in 1980. Total earnings will increase further to \$8,874,000 (1970 dollars) in 2000.

The earnings of the construction, mining, and railroad workers represent an injection of new income into the impact area. As it is spent and respent within the region, additional incomes are created. The

relationship between basic and derived earnings is usually summarized using an earnings multiplier. This figure is an estimate of the increase in earnings--the wages, salaries, and proprietor's income--in derivative industries created by an additional dollar of earnings in the basic industries.² The earnings multiplier does not represent gross business activity--it does not measure the change in total sales. Rather, it is defined in terms of personal earnings to individuals, a figure which is net of the costs of production.

The increase in derivative earnings and employment are projected to occur in Big Horn and Sheridan Counties. That is, Rosebud County has been excluded from the impact area. Although it is geographically situated near the proposed mine sites, there are few economic links to Rosebud County.³ Only a gravel road connects southeastern Big Horn County with Rosebud County and almost all of the commerce and community patterns in the area near the proposed mines are oriented toward Sheridan. In order to avoid confusion, the economic impact area will be hereafter denoted as the Big Horn-Sheridan impact area.

Based on the statistical analysis of the Big Horn-Sheridan impact, derivative earnings are projected to increase by \$0.80 for each \$1.00 increase in the earnings of permanent mine workers and railroad employees, \$0.40 for each \$1.00 increase in earnings of construction workers, and

²This approach will underestimate the local economic impact to the extent that the basic industries make local purchases of goods and services in addition to the payroll of their employees. These purchases, sometimes called "linkages," are usually thought to be relatively small in rural areas with few firms engaged in intermediate production, where the output of one firm is an input for another.

³Statistical analysis of past data suggests there are no significant economic interrelationships between the Big Horn-Sheridan area and Rosebud County.

to decrease by \$0.49 for each \$1.00 decline in gross farm receipts (see section entitled "Statistical findings and projection methodology," p. G-76).

Projected derivative earnings for Decker mine proposals are presented in table G-21. These figures are net of the negative impact on agriculture due to the removal of land from farm production at the mine sites. During 1976, the derivative earnings associated with the North Extension Mine are projected to be \$1,071,000 (1970 dollars). This figure declines to \$820,000 (1970 dollars) in 1977, due to the termination of the site preparation jobs, but then experiences steady growth to \$1,409,000 (1970 dollars) in 2000. Derivative earnings associated with the East Decker Mine are projected to be \$813,000 (1970 dollars) in 1976 and then grow to \$5,643,000 (1970 dollars) in 2000. Taken together, the two Decker mines are projected to be associated with an increase of \$1,884,000 (1970 dollars) in derivative earnings during 1976. This figure is projected to increase to \$7,052,000 (1970 dollars) in 2000. The greatest single year increase will occur during 1978, when production begins at the East Decker Mine.

The projected changes in derivative earnings are based on estimates derived from data for the Big Horn-Sheridan impact area. The changes in derivative employment, however, are more difficult to predict. The increase in derivative jobs depends on the nature of the new positions. For example, the \$813,000 (1970 dollars) in derivative earnings associated with the East Decker Mine in 1976 could correspond to about 81 new derivative jobs if each paid \$10,000 per year. Or, approximately 162 new jobs at \$5,000 per year. In the absence of accurate and detailed projections of the characteristics of the new derivative jobs, there is almost an infinite number of possibilities for the change in derivative employment.

Table G-21

Projected Derivative Earnings and Potential New Derivative Jobs
Big Horn-Sheridan Impact Area
1976 to 2000

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> | <u>1985</u> | <u>2000</u> |
|--------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <u>North Extension Mine</u> | | | | | | | |
| Derivative earnings (thousands of 1970 dollars) ^a | \$1,071 | \$ 820 | \$ 840 | \$ 857 | \$ 880 | \$ 992 | \$1,409 |
| Potential new derivative jobs | | | | | | | |
| "Average" jobs ^b | 190 | 140 | 130 | 120 | 120 | 120 | 110 |
| FTE jobs ^c | 140 | 100 | 90 | 90 | 80 | 80 | 70 |
| <u>East Decker Mine</u> | | | | | | | |
| Derivative earnings (thousands of 1970 dollars) ^a | \$ 813 | \$1,089 | \$2,865 | \$3,209 | \$3,548 | \$3,990 | \$5,643 |
| Potential new derivative jobs | | | | | | | |
| "Average" jobs ^b | 140 | 180 | 440 | 450 | 470 | 470 | 440 |
| FTE jobs ^c | 100 | 130 | 320 | 320 | 340 | 330 | 290 |
| <u>Total, North Extension and East Decker Mine</u> | | | | | | | |
| Derivative earnings (thousands of 1970 dollars) ^a | \$1,884 | \$1,909 | \$3,705 | \$4,068 | \$4,428 | \$4,982 | \$7,052 |
| Potential new derivative jobs | | | | | | | |
| "Average" jobs ^b | 330 | 320 | 570 | 570 | 590 | 590 | 550 |
| FTE jobs ^c | 240 | 230 | 410 | 410 | 420 | 410 | 360 |

^a Includes impact of projected decline in agricultural production due to mining activity.

^b New derivative jobs are similar to existing positions.

^c New derivative jobs are full-time positions (2,000 work hours per year).

A range of reasonable values, however, may be derived by making some judicious assumptions concerning the earnings of derivative workers.

The average derivative worker in the Big Horn-Sheridan impact area is projected to earn \$5,700 (1970 dollars) per year in 1976.⁴ Combining this value with the projected \$813,000 (1970 dollars) increase in total derivative earnings for the East Decker Mine yields an employment estimate of approximately 140 derivative workers. This figure corresponds to the assumption that the new jobs are, on the average, identical to the existing ones.

Many derivative positions, especially those in retail trade and the services, are part-time or seasonal. A second employment estimate may be made by assuming that all new derivative jobs are full-time; that is, they involve 40 hours a week for 50 weeks a year for a total of 2,000 hours of work per year. The average derivative worker is projected to work about 1,456 hours per year in 1976.⁵ This implies that the average derivative job corresponds to about .728 ($1,456/2,000 = .728$) Full Time Equivalents. If earnings are proportional to worktime, the FTE earnings of derivative workers would be about \$7,830 ($\$5,700/.728 = \$7,829.67$). Thus, if each job were a full-time position, the \$813,000 (1970 dollars) increase in derivative earnings would correspond to about 100 ($\$813,000/7,830 = 103.8$) new derivative workers.

The timing of the new derivative jobs presents an additional problem. Annual projections for derivative employment are presented for 1976 to 1980. But, simply because new positions may be needed at these times

⁴The details of this calculation are presented in the section entitled "Statistical findings and projective methodology," p. G-76.

⁵The details are presented in the section entitled "Statistical findings and projective methodology," p. G-76.

does not mean that more persons will be immediately put to work. For example, a business may experience an increase in sales so that it "needs" more employees; but the manager--perhaps out of ignorance or because he is cautious--may not immediately hire additional personnel. The projections have been labeled "potential new derivative jobs" and should be interpreted with a grain of salt; they are not precise predictions and are intended to only approximate the change in the derivative industries.⁶

The projections in table G-21 show that the North Extension mine is associated with a potential of 190 new derivative jobs in 1976 if the new positions are similar to the existing ones. This figure declines to 140 in 1977 and then to 110 in 2000. The FTE equivalents are 140 jobs in 1976, 100 in 1977, and then decreasing to 70 jobs in 2000. The East Decker Mine is projected to create about 140 potential new derivative jobs in 1976. The number of new jobs will peak at approximately 470 in 1980 and 1985 and then decline to about 440 positions in 2000. The FTE equivalents are 100 jobs in 1976, 340 and 330 jobs in 1980 and 1985, respectively, and 290 jobs in 2000. Taken together, the North Extension and the East Decker Mines have the potential for creating between 240 and 330 new derivative jobs in the Big Horn-Sheridan impact area during 1976. These figures reach a maximum of approximately 420 to 590 jobs in 1980 and 1985 and decline slightly to between 360 and 550 jobs in 2000.

The greatest attention will undoubtedly be centered on the new basic jobs directly concerned with the new Decker mines. The new derivative jobs will occur quietly throughout the local economy and will not

⁶The projected change in derivative earnings does not depend on the number of new derivative jobs. If fewer positions are created, the excess earnings may be paid to existing workers, perhaps in overtime pay or upgrading part-time jobs to full-time, or accrue to the owners in the form of increased proprietors' income.

be obviously identified with coal development. They will be represented by a new clerk at the grocery store, additional telephone repairmen transferred into the area, or an expanded service department at the auto dealership and will be indistinguishable from other jobs in retail trade, services and local government. That is, they will cater to the entire population, not just mines or other coal-related workers.

The total number of derivative jobs is projected to decline slightly after 1985 and there is a significant decrease associated with the North Extension Mine between 1976 and 1977. These vacillations should not be viewed with alarm and need not imply that people will be suddenly thrown out of work. First of all, the projections of derivative employment, especially the annual figures for 1976 to 1980, are not very precise. For example, given the time lags present in the derivative industries, the entire 190 new jobs projected for the North Extension Mine in 1976 may not materialize. Secondly, the decline projected during the 1985-2000 period will occur over many years.⁷ Many jobs in the trades and services are part-time and have high employee turnover. Moderate declines may be accommodated through normal attrition.

A summary of the employment and earnings effects of the proposed Decker mines in the Big Horn-Sheridan impact area are present in table G-22. These figures show that, taken together, the mines are projected to directly and indirectly generate approximately \$5,564,000 (1970 dollars) in increased earnings in 1976.⁸ The corresponding growth in employment

⁷This decline is due to the projection that earnings per derivative worker will increase at a faster rate than earnings per basic worker.

⁸Projected earnings underestimate the change in personal income because they do not include transfer payments and property income. These items, however, are relatively independent of local economic conditions and the degree of understatement is probably small.

Table G-22

Projected Basic and Derivative Earnings and Employment, Proposed Decker Mines
Big Horn-Sheridan Impact Area
1976 to 2000

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> | <u>1985</u> | <u>2000</u> |
|--------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <u>North Extension Mine</u> | | | | | | | |
| Basic and derivative earnings (thousands of 1970 dollars) | \$2,718 | \$1,874 | \$1,919 | \$1,963 | \$2,009 | \$2,261 | \$3,200 |
| Basic and derivative employment ^b | 265-315 | 175-215 | 165-205 | 165-195 | 155-195 | 155-195 | 145-185 |
| <u>East Decker Mine</u> | | | | | | | |
| Basic and derivative earnings (thousands of 1970 dollars) | \$2,846 | \$3,810 | \$6,868 | \$7,249 | \$8,013 | \$9,007 | \$12,726 |
| Basic and derivative employment ^b | 265-305 | 345-395 | 605-725 | 595-725 | 637-767 | 627-767 | 587-737 |
| <u>Total, North Extension and East Decker Mines</u> | | | | | | | |
| Basic and derivative earnings (thousands of 1970 dollars) | \$5,564 | \$5,684 | \$8,787 | \$9,212 | \$10,022 | \$11,268 | \$15,926 |
| Basic and derivative employment ^b | 530-620 | 520-610 | 770-930 | 760-920 | 792-962 | 782-962 | 732-922 |

Source: Tables G-20 and G-21

^a Includes impact of projected decline in agricultural production due to mining activity.

^b The higher figure corresponds to the assumption that the new derivative jobs are similar to existing positions while the lower figure corresponds to the assumption that the new derivative jobs are full-time positions.

opportunities will be between 530 and 620 new jobs. Basic and derivative earnings are projected to increase throughout the life of the project. Employment opportunities will peak between 1980 and 1985 and will decline slowly in the following years.

The magnitude of the projected impacts may be put in perspective by comparing them to current levels of earnings and employment. During 1972, the Big Horn-Sheridan impact area had total earnings of about \$81,100,000 (1970 dollars) and total employment of 11,598. Therefore, the projected 1976 values represent about 7 percent of the 1972 level of earnings and between 4.5 and 5.3 percent of total employment. Since most of the workers will live in and near Sheridan the figures for the entire impact area may understate the effect on the local labor market. During 1972, total employment in Sheridan County was 7,856. The 1976 projected increase in total job opportunities represents between 6.7 and 7.9 percent of this figure.

The projected earnings per worker in coal-related and derivative industries in the Big Horn-Sheridan impact area are presented in table G-23. The new coal-related jobs--the miners and railroad workers--will be well-paying positions; they are projected to average between \$14,098 (1970 dollars) and \$15,126 (1970 dollars) per year. This is well above the projected average earnings of approximately \$12,000 per year for existing nonagricultural basic industries currently operating in the impact area.⁹ The high pay of these positions suggests the number of new derivative jobs created for each additional coal-related jobs will be well above the historic ratio of derivative-to-basic jobs for this area.

⁹ During 1972, nonagricultural basic industries paid, on the average, about \$9,400 (1970 dollars) per year. It was projected to rise at a 3 percent compound rate--a rather optimistic assumption--between 1972 and 1980.

Table G-23

Projected Earnings per Worker
Coal-Related and Derivative Industries
Big Horn-Sheridan Impact Area
1980

(In 1970 Dollars)

| | <u>Projected Earnings per Worker</u> |
|-------------------------|------------------------------------------|
| Coal-related industries | |
| Coal mining | \$15,126 |
| Railroads | 14,098 |
| Derivative industries | |
| "Average" job | \$ 7,470 |
| FTE jobs ^{1/} | 10,430 |

Source: Appendix tables G-23 and G-34.

^{1/} Full time equivalents (see p. G-49).

The derivative jobs, on the other hand, are projected to average \$7,470 (1970 dollars) per year in 1980, with FTE earnings of \$10,430 (1970 dollars) per year. The lower pay does not make these positions inherently undesirable. Many may be part-time and require little training. If historical patterns prevail, many of these jobs may go to women and young people, who appear to suffer disproportionately from real and disguised unemployment.

Earnings per worker in derivative industries are determined, to a great extent, by the conditions in the local labor market. The increase in the demand for labor is projected to cause these earnings to increase at a much faster rate between 1976 and 1980 than would have occurred in the absence of the proposed Decker mines. After 1980, however, impact due to the proposed Decker mines will have stabilized and there will be little effect on rate of change in earnings per derivative worker.¹⁰

¹⁰This process is detailed in the section entitled "Statistical findings and projection methodology," p. G-77.

Government expenditures and revenues

The change in government expenditures and revenues due to the proposed Decker mines are difficult to project in a totally reliable manner. In the first place, legislative action may alter the tax rates and other provisions of the tax laws. Secondly, the increased demand for public services are usually channeled through political processes and are subject to time lags and other influences not fully understood by economists. Finally, the precise changes in expenditures and revenues for individual government units will depend on where the new residents live and their choice of accommodations, i.e., whether they live inside the City of Sheridan and whether they build a single family dwelling or live in a mobile home. The projections of increased expenditures and revenues should not be viewed as absolutely precise forecasts of the financial situation of the various government units. Instead, they represent only the incremental effects of the proposed Decker mines on government expenditures and revenues. All projections are stated in 1970 dollars to eliminate the effects of inflation.

Governments in Montana

The 1975 Legislature made major revisions in the provisions of Montana's coal taxes. Even though these changes became effective July 1, 1975, all the legal implications have not yet been determined and the Montana Department of Revenue has not completely established the specific regulations and guidelines for the calculation of tax liabilities. The projections of the tax revenue from the proposed Decker mines are

based on preliminary interpretations of the relevant laws and conversations with the staff of the Montana Department of Revenue. They should, therefore, be interpreted with caution; later revisions in administrative procedures or new legal interpretations may significantly alter the potential revenue from these taxes.

The combined tax revenues from the North Extension and the East Decker Mines are presented in table G-24. The figures for the individual mines are shown in tables G-25 and G-26. These projections are based on proposed levels of production and contract price information supplied by the Decker Coal Company. In order to calculate the tax liabilities, it was assumed that one-fourth of the annual coal production occurs during each calendar quarter. Also, to estimate the relevant contract price per ton, it was assumed that all of the Coal Mine License Tax, the Gross Proceeds Tax, and the Resource Indemnity Trust Tax will be passed through to the purchaser of the coal by the escalation clauses in the sales contracts. Projections are presented to 1980; the accuracy of these figures depends, of course, on the tax laws remaining constant throughout the period.

The largest source of revenue for Montana governments will be the Coal Mines License Tax. At full production levels, the North Extension and the East Decker Mines will generate about \$2,282,000 (1970 dollars), and \$12,707,000 (1970 dollars) to the State of Montana, respectively. Of this total, approximately \$5,436,000 (1970 dollars) will be earmarked for the Local Impact and Education Trust Fund. Until June 30, 1979, 7/11 of the revenue in this trust fund may be expended for grants to assist local governments and school districts in coal impact areas. After June 30, 1979, only 3/7 of the revenue may be spent in this manner.

Table G-24

Projected Increase in Total Tax Revenues, by Tax
North Extension Mine and the East Decker Mine

(1970 Dollars)

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> |
|---------------------------------------|-------------|-------------|--------------|--------------|--------------|
| <u>State of Montana</u> | | | | | |
| Coal Mines License Tax | \$1,702,500 | \$2,270,100 | \$11,339,700 | \$14,774,200 | \$14,988,800 |
| Local Impact and Education Trust Fund | 487,700 | 650,300 | 3,248,400 | 4,814,600 | 5,436,400 |
| Coal Area Highway Improvement Account | 177,400 | 236,500 | 1,181,300 | 762,300 | -- |
| Gross Proceeds Tax | -- | 19,100 | 19,100 | 120,000 | 124,600 |
| Resource Indemnity Trust Tax | -- | 53,300 | 53,300 | 335,300 | 348,000 |
| Property Tax | 2,900 | 6,000 | 17,500 | 29,000 | 29,000 |
| Montana Individual Income Tax | 99,800 | 103,300 | 139,400 | 139,200 | 166,600 |
| Total, all taxes | \$1,805,200 | \$2,451,800 | \$11,569,000 | \$15,397,700 | \$15,657,000 |
| <u>Big Horn County</u> | | | | | |
| Coal Mines License Tax | \$ 70,900 | \$ 94,600 | \$ 472,500 | \$ 615,600 | \$ 543,700 |
| Gross Proceeds Tax | -- | 237,700 | 237,700 | 1,493,700 | 1,550,700 |
| Property Tax | 37,300 | 74,600 | 218,100 | 361,600 | 361,700 |
| Total, all taxes | \$ 108,200 | \$ 406,900 | \$ 928,300 | \$ 2,470,900 | \$ 2,456,100 |
| <u>High School District 12</u> | | | | | |
| Gross Proceeds Tax | \$ -- | \$ 7,200 | \$ 7,200 | \$ 45,100 | \$ 46,800 |
| Property Tax | 1,100 | 2,200 | 6,600 | 10,900 | 10,900 |
| Total, all taxes | \$ 1,100 | \$ 9,400 | \$ 13,800 | \$ 56,000 | \$ 57,700 |
| <u>Elementary School District 1</u> | | | | | |
| Gross Proceeds Tax | \$ -- | \$ 8,500 | \$ 8,500 | \$ 53,600 | \$ 55,600 |
| Property Tax | 1,400 | 2,600 | 7,800 | 13,000 | 13,000 |
| Total, all taxes | \$ 1,400 | \$ 11,100 | \$ 16,300 | \$ 66,600 | \$ 68,600 |

Note: See notes on tables G-25 and G-26 for assumptions used in projecting tax revenues.

Table G-25
Projected Increase in Tax Revenues, by Tax
North Extension Mine
(1970 Dollars)

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> |
|---------------------------------------|-------------|-------------|-------------|-------------|-------------|
| <u>State of Montana</u> | | | | | |
| Coal Mines License Tax | \$1,702,500 | \$2,270,100 | \$2,270,100 | \$2,270,100 | \$2,281,800 |
| Local Impact and Education Trust Fund | 487,700 | 650,300 | 650,300 | 738,900 | 827,600 |
| Coal Area Highway Improvement Account | 177,400 | 236,500 | 236,500 | 118,200 | -- |
| Gross Proceeds Tax | -- | 19,100 | 19,100 | 19,100 | 19,100 |
| Resource Indemnity Trust Tax | -- | 53,300 | 53,300 | 53,300 | 53,300 |
| Property Tax | 2,900 | 5,900 | 5,800 | 5,800 | 5,800 |
| Montana Individual Income Tax | 43,900 | 30,400 | 30,400 | 30,400 | 34,300 |
| Total, all taxes | \$1,749,300 | \$2,378,800 | \$2,378,700 | \$2,378,700 | \$2,394,300 |
| <u>Big Horn County</u> | | | | | |
| Coal Mines License Tax | \$ 70,900 | \$ 94,600 | \$ 94,600 | \$ 94,600 | \$ 82,800 |
| Gross Proceeds Tax | -- | 237,700 | 237,700 | 237,700 | 237,700 |
| Property Tax | 36,600 | 73,000 | 72,800 | 72,700 | 72,700 |
| Total, all taxes | \$ 107,500 | \$ 405,300 | \$ 405,100 | \$ 405,000 | \$ 393,200 |
| <u>High School District 12</u> | | | | | |
| Gross Proceeds Tax | \$ -- | \$ 7,200 | \$ 7,200 | \$ 7,200 | \$ 7,200 |
| Property Tax | 1,100 | 2,200 | 2,200 | 2,200 | 2,200 |
| Total, all taxes | \$ 1,100 | \$ 9,400 | \$ 9,400 | \$ 9,400 | \$ 9,400 |
| <u>Elementary School District 1</u> | | | | | |
| Gross Proceeds Tax | \$ -- | \$ 8,500 | \$ 8,500 | \$ 8,500 | \$ 8,500 |
| Property Tax | 1,400 | 2,600 | 2,600 | 2,600 | 2,600 |
| Total, all taxes | \$ 1,400 | \$ 11,100 | \$ 11,100 | \$ 11,100 | \$ 11,100 |

Note: The tax revenue projections are based on the following assumptions: a production level of 2 million tons per year (500,000 tons per quarter); a "contract sales price" of \$5.00 per ton; 100 percent of the Coal Mines License Tax, Gross Proceeds Tax, and Resource Indemnity Trust Tax are passed through to the purchaser; payment of the Coal Mines License Tax is made within 30 days of the end of each calendar quarter; payment of the Gross Proceeds Tax and the Resource Indemnity Trust Tax are made in the year following production; payment of the property tax is made one-half in the taxable year, one-half in the following year; payment of the Montana Individual Income Tax is made by withholding in the year the income is earned; property tax mill levies will remain at fiscal 1975 levels; the current coal and property tax laws will not be materially changed during the time period of the projections.

Table G-26
Projected Increase in Tax Revenues, by Tax
East Decker Mine

(1970 Dollars)

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> |
|---------------------------------------|--------------------|--------------------|-------------|--------------|--------------|
| <u>State of Montana</u> | | | | | |
| Coal Mines License Tax | \$ -- | \$ -- | \$9,069,600 | \$12,504,100 | \$12,707,000 |
| Local Impact and Education Trust Fund | -- | -- | 2,598,100 | 4,075,700 | 4,608,800 |
| Coal Area Highway Improvement Account | -- | -- | 944,800 | 644,100 | -- |
| Gross Proceeds Tax | -- | -- | -- | 100,900 | 105,500 |
| Resource Indemnity Trust Tax | -- ^a | -- | -- | 282,000 | 294,700 |
| Property Tax | -- | 100 | 11,700 | 23,200 | 23,200 |
| Montana Individual Income Tax | 55,900 | 72,900 | 109,000 | 108,800 | 132,300 |
| Total, all taxes | \$55,900 | \$73,000 | \$9,190,300 | \$13,019,000 | \$13,262,700 |
| <u>Big Horn County</u> | | | | | |
| Coal Mines License Tax | \$ -- | \$ -- | \$ 377,900 | \$ 521,000 | \$ 460,900 |
| Gross Proceeds Tax | -- | -- | -- | 1,256,000 | 1,313,000 |
| Property Tax | 700 | 1,600 | 145,300 | 288,900 | 289,000 |
| Total, all taxes | \$ 700 | \$ 1,600 | \$ 523,200 | \$ 2,065,900 | \$ 2,062,900 |
| <u>High School District 12</u> | | | | | |
| Gross Proceeds Tax | \$ -- ^a | \$ -- ^a | \$ -- | \$ 37,900 | \$ 39,600 |
| Property tax | -- | -- | 4,400 | 8,700 | 8,700 |
| Total, all taxes | \$ ^a | \$ ^a | \$ 4,400 | \$ 46,600 | \$ 48,300 |
| <u>Elementary School District 1</u> | | | | | |
| Gross Proceeds Tax | \$ -- ^a | \$ -- ^a | \$ -- | \$ 45,100 | \$ 47,100 |
| Property Tax | -- | -- | 5,200 | 10,400 | 10,400 |
| Total, all taxes | \$ ^a | \$ ^a | \$ 5,200 | \$ 55,500 | \$ 57,500 |

Note: The tax revenue projections are based on the following assumptions: a production level of 10 million tons per year (2.5 million tons per quarter); an average "contract sales price" of \$5.2844 per ton in 1978 and \$5.5240 for subsequent years; 100 percent of the Coal Mines License Tax, Gross Proceeds Tax, and Resource Indemnity Trust Tax are passed through to the purchaser; payment of the Coal Mines License Tax is made within 30 days of the end of each calendar quarter; payment of the Gross Proceeds Tax and the Resource Indemnity Trust Tax are made in the year following production; payment of the property tax is made one-half in the taxable year, one-half in the following year; payment of the Montana Individual Income Tax is made by withholding in the year the income is earned; property tax mill levies will remain at fiscal 1975 levels; the current coal and property tax laws will not be materially changed during the time period of the projections.

^aLess than \$100.

From 1976 through 1979, a total of \$2,375,500 (1970 dollars) of the Coal Mines License Tax revenues will accrue to the Coal Area Highway Improvement account for expenditure by the Department of Highways to improve the roads in coal development areas. Of course, there is no guarantee that the state will spend these local impact and highway trust fund revenues in Big Horn County, but it is likely that at least a portion will benefit this county.

The portion of the Coal Mines License Tax going directly to Big Horn County from both mines will total \$615,600 (1970 dollars) in 1979 and then drop slightly to \$543,700 in 1980 because of the decline in the county's percentage of the revenue from 4.0 percent to 3.5 percent.

The Gross Proceeds Tax revenue generated by the proposed projects should prove to be the largest source of new revenue to the county government. The gross proceeds of the mining operations, totaling about \$65,000,000 (1970 dollars) per year for the two projects will be added to the base of the property tax at 40 percent of its value. Based on 1975 mill levy rates for Big Horn County, this will add about \$1,551,000 (1970 dollars) to the county treasury during 1980. In addition, based on current mill levies, about \$125,000 (1970 dollars) will accrue to the State of Montana and \$100,000 (1970 dollars) to the two school districts in 1980.

The Resource Indemnity Trust Tax is based on the gross value of the product extracted which apparently will include the amount of the Coal Mines License Tax and Gross Proceeds Tax included in the final selling price, F.O.B. mine. Total revenue from this tax should be slightly under \$350,000 (1970 dollars) per year by 1980. This revenue will be credited to the Resources Indemnity Trust Fund of the State of Montana for later

expenditure to "improve the total environment and rectify damage thereto."

Two sources of increase in the tax base were used to project property tax revenues; (1) the valuation of the mine plant, equipment, and railroad spur for both projects, and (2) the valuation of private housing developed to house new residents projected to live in Big Horn County.

Decker Coal Company estimates that construction and equipment costs will be \$10,000,000 for the North Expansion Mine and \$40,000,000 for the East Decker Mine, in current (1975) dollars. The addition of these mines to the tax roles will increase the taxable valuation of Big Horn County by \$1,200,000 and \$4,800,000, respectively, in current dollars.

The valuation of new housing in Big Horn County was based on the assumption that 10 percent of the new housing units would be single family dwellings and that 90 percent will be mobile homes or apartments. The selling price of the former is projected to be \$32,000 including land while the latter will average \$9,550 per unit, with both figures in current dollars. In 1980, new housing for the North Extension will add \$22,500 in taxable value to the tax roles and the East Decker Mine will add \$89,500 in taxable valuation, in current dollars.

The property tax revenues were derived by applying the 1975 mill levy rates applicable in Big Horn County to the total increase in taxable value for the county. In 1980, property tax collections should total \$414,600 (1970 dollars) as a result of both projects, with \$29,000 (1970 dollars) going to the state, \$361,700 (1970 dollars) to Big Horn County, and \$23,900 (1970 dollars) to the two school districts.

All incomes earned in Montana are subject to the Montana Individual Income Tax and the revenue is paid to the state. The earnings of all miners and construction employees working at the mine sites, even if

they live in Wyoming, will be subject to this tax. Further, the tax will also apply to increased derivative earnings in Montana. But, since the number of new derivative jobs in Big Horn County will probably be small, the projected income tax revenue is based only on the earnings of miners and construction workers.

The income tax rates are graduated starting at 2 percent for taxable incomes of less than \$1,000 and increasing to 11 percent for taxable incomes in excess of \$35,000.¹ The tax liability of each person depends on his deductions, exemptions, and adjustments. Based on all 1972 Montana income tax returns and adjusting for the change in the surtax, the following table of average tax liability by income brackets was derived.

| <u>Montana Adjusted Gross Income</u> | <u>Average Tax</u> |
|------------------------------------------|------------------------|
| \$12,000-12,999 | \$339 |
| 13,000-13,999 | 385 |
| 14,000-14,999 | 435 |
| 15,000-15,999 | 490 |

These estimates were then applied to the number of coal mining and construction workers in each income bracket to derive the income tax revenue.

Tax revenues from the Montana Individual Income Tax are projected to be \$99,800 (1970 dollars) in 1976 and then grow to \$166,600 (1970 dollars) in 1980.

The revenues from the Montana Corporation License Tax are not projected because they would require the calculation of net income earned in Montana and would have to consider the overall corporate profitability

¹Revised Codes of Montana, 1947, Section 84-4902.

as reflected by the federal corporate tax provisions.

Projected growth in operational expenditures for the State of Montana, Big Horn County, and the two affected school districts are presented in table G-27. These figures are based on the assumption that each new resident adds \$75.00 (1970 dollars) to the expenditures of Big Horn County and \$300 to the expenditures of the State of Montana.² School operating costs were projected on the basis of \$700 (1970 dollars) per pupil, which approximates the 1973-74 average for school districts in the area. Increased construction costs for the affected school districts are also shown; they are projected using \$3,300 (1970 dollars) per pupil. The payments for additional facilities are only "one shot" expenditures and need not be repeated once the buildings are completed. The projected growth in expenditures for Montana governments probably overestimate the change which will actually occur. The increased population and school enrollments are very small when compared to current levels and may not require proportionate increases in all forms of government services.

The increase in expenditures for the State of Montana will be much less than the increase in tax revenues associated with the mine projects. As shown in table G-27, the total increase in state expenditures is projected to be \$57,000 (1970 dollars) in 1980 compared to \$15,657,000 (1970 dollars) in tax revenues. Only during the construction phase (1976 and 1977) of the East Decker Mine, before coal production begins, will the increase in the state government expenditures for this mine total more than 10 percent of the corresponding increase in revenue.

²The projected expenditures are derived from Paul E. Polzin, *Water Use and Coal Development in Eastern Montana*, Bureau of Business and Economic Research, University of Montana, 1974, pp. 148-153.

Table G-29

Projected Expenditures and Total Tax Revenues for Montana Governments
Proposed Decker Mines

(1970 Dollars)

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> |
|-------------------------------------------------------------|-----------------|-----------------|-------------|-------------|-------------|
| <u>North Extension Mine</u> | | | | | |
| State of Montana | | | | | |
| Expenditures | \$ 18,000 | \$ 12,300 | 11,700 | \$ 11,700 | \$ 11,100 |
| Revenues, all taxes | 1,749,300 | 2,378,800 | \$2,378,700 | 2,378,700 | 2,394,300 |
| Big Horn County | | | | | |
| Expenditures | 4,500 | 3,100 | 2,900 | 2,900 | 2,800 |
| Revenues, all taxes | 107,500 | 405,300 | 405,100 | 405,000 | 393,200 |
| High School District 12 and Elementary School District 1 | | | | | |
| Expenditures, operating | 11,900 | 8,400 | 8,400 | 8,400 | 7,700 |
| Additional facilities | 56,100 | | | | |
| Expenditures, total | 68,000 | 8,400 | 8,400 | 8,400 | 7,700 |
| Revenues, all taxes | 2,500 | 20,500 | 20,500 | 20,500 | 20,500 |
| <u>East Decker Mine</u> | | | | | |
| State of Montana | | | | | |
| Expenditures | 16,800 | 21,900 | 42,300 | 42,900 | 45,900 |
| Revenues, all taxes | 55,900 | 73,000 | 9,190,300 | 13,019,000 | 13,262,700 |
| Big Horn County | | | | | |
| Expenditures | 4,200 | 5,500 | 10,600 | 10,700 | 11,500 |
| Revenues, all taxes | 700 | 1,600 | 523,200 | 2,065,900 | 2,062,900 |
| High School District 12 and Elementary District 1 | | | | | |
| Expenditures, operating | 10,500 | 13,300 | 28,700 | 29,400 | 31,500 |
| Additional facilities | 62,700 | | 85,800 | | |
| Expenditures, total | 73,200 | 13,300 | 114,500 | 29,400 | 31,500 |
| Revenues, all taxes | -- ^a | -- ^a | 5,200 | 55,500 | 57,500 |
| <u>Total, North Extension and East Decker Mines</u> | | | | | |
| State of Montana | | | | | |
| Expenditures | 34,800 | 34,200 | 54,000 | 54,600 | 57,000 |
| Revenues, all taxes | 1,805,200 | 2,451,800 | 11,569,000 | 15,397,700 | 15,657,000 |
| Big Horn County | | | | | |
| Expenditures | 8,700 | 8,600 | 13,500 | 13,600 | 14,250 |
| Revenues, all taxes | 108,200 | 406,900 | 928,300 | 2,470,900 | 2,456,100 |
| High School District 12 and Elementary District 1 | | | | | |
| Expenditures, operating | 22,400 | 21,700 | 37,100 | 37,800 | 39,200 |
| Additional facilities | 118,800 | | 85,800 | | |
| Expenditures, total | 141,200 | 21,700 | 122,900 | 37,800 | 39,200 |
| Revenues, all taxes | 2,500 | 20,500 | 25,700 | 76,000 | 78,000 |

^a Less than \$100.

The situation will be much the same for Big Horn County. Total additional expenditures from the combined mines will be \$14,250 (1970 dollars) in 1980 and tax revenues will be \$2,456,000 (1970 dollars). During the construction period of the East Decker Mine, expenditures will exceed revenues slightly (by \$3,500 in 1976 and \$3,900 in 1977); but, if both projects are approved, total revenues from the two mines will be about 12 times the additional expenditures in 1976, and about 47 times as large in 1977.

The projections for High School District 12 and Elementary District 1, in table G-27, indicate that taxes levied by the school districts will not be sufficient to cover the projected facilities construction or the operating costs of the districts until 1979. However, the revenues projected for the Montana school districts represent only the tax revenue from the districts' mill levies and do not include the county and state levies for the education equalization program which provide most of the districts' funding. Since about half of the county's property tax and gross proceeds tax collections are earmarked for education, and 10 percent of the Coal Mines License Tax and 25 percent of the state income tax revenues are earmarked for education equalization aid, increases in these taxes will more than offset any deficits in the districts' operating budgets. The projected capital expenditures may not be required if the additional school children (which are projected to number less than 60) are to be distributed throughout the districts to utilize any existing excess capacity.

Governments in Sheridan County, Wyoming

Increased expenditures and revenues are projected for Sheridan

County, the City of Sheridan, and Sheridan School District 2. Unlike Montana, annual projections are not presented. Instead, expenditures and revenues are projected for a "typical" year during the operational phase of the proposed mines. These figures may more accurately reflect the long-run trends as they begin to affect local governments. The year 1980 was chosen because it is after the construction period and both proposed mines are scheduled to be in full production.

The increase in operational expenditures due to the proposed Decker mines are projected for the City of Sheridan and Sheridan County. These figures do not include capital items, such as a new courthouse or sewer plant which require only a "one shot" expenditure of funds, nor do they include the repayment of debt and interest charges due to new buildings and facilities. Operating expenses, including ongoing activities which are financed on a continuing basis, are likely to be affected by the proposed Decker mines.

The per capita operating expenses for the City of Sheridan and Sheridan County are projected to be \$104.00 (1970 dollars) and \$47.00 (1970 dollars), respectively, during 1980. These figures approximate the budgeted expenditures for selected categories during fiscal 1975.³ There is some evidence that per capita expenditures in northern Wyoming communities tend to decline with increased population.⁴ Also, it is

³For the City of Sheridan, they include all General Fund expenditures less Federal Revenue Sharing projects. The expenditures for Sheridan County include General Fund expenditures (less Federal Revenue Sharing Projects), the Welfare and Health Funds, the Library Fund, and the Fair Fund.

⁴Intermountain Planners and Werth-Berger Associates, *Capital Facilities Study Powder River Basin*, a report for the Wyoming Department of Economic Planning and Development, 1974, pp. 61-85.

assumed that the entire increase in the population of Sheridan County will occur in the City of Sheridan. This implies there may be some double counting of expenditures. For example, it is doubtful that the expenses of the Sheriff's Office will increase by the full amount if all the new residents are also within the jurisdiction of the Sheridan Police Department. In short, the projected increases are probably on the high side and should be interpreted as estimating the maximum potential rise in expenditures.

Revenue projections for 1980 were derived for the increase in local property taxes and the distributions of the sales and use taxes, the cigarette tax, and the gasoline tax. Because it is required to be used mostly for streets and roads, the projected gasoline tax distribution is listed separately.

The change in local property taxes was derived by first projecting the increase in assessed valuation and then applying the appropriate mill rates for the City of Sheridan and Sheridan County. These projections may quickly become obsolete because Wyoming is presently implementing a new statewide assessment policy. The full implications of the new practices for assessed valuation and the associated mill levies is not yet known. The projected property tax revenues are probably very conservative because the growth in assessed valuation is due only to the additional homes, apartments, and mobile homes of the new residents. The additional personal property and the increased valuation of businesses have been excluded.⁵

⁵The new housing units associated with the Decker mines are projected to consist mostly of mobile homes. This is a significant departure from the current dominance of single family dwellings. Thus, historical figures for assessed value per capita may not be a reliable indicator for future trends.

Housing projections assumed about 10 percent of the new housing units will be single family dwellings and the remainder will be mobile homes or apartments. The selling price of the former is projected to be \$32,000 (1970 dollars) including land, while the latter is projected to average \$9,550 (1970 dollars) per unit. The ratio of assessed value to selling price is projected to be .17, approximately the value for selected Wyoming counties during 1971.⁷ The tax rates for the City of Sheridan and Sheridan County are 7.4 and 9.04 mills, respectively, which are equal to the rates for fiscal 1975.⁸

The increase in retail sales for Sheridan County has not been projected. But, between 1969 and 1973, the total sales tax distribution to all government units in Sheridan County consistently averaged between 0.29 and 0.31 percent of total personal income.⁹ During this period, one-sixth of the tax collections less administrative costs were returned to local governments. Beginning in 1975, this figure rises to one-third and a portion of the use tax is also included in the distribution. For 1980, sales and use tax distributions are projected to be 0.62 percent of the change in personal income with the City of Sheridan and Sheridan County receiving 61 percent and 35 percent of the total, respectively.¹⁰

⁷U. S. Bureau of the Census, Census of Governments, 1972, Part 2: *Assessment-Sales Price Ratios and Tax Rates* (Washington, D.C.: U. S. Government Printing Office, 1973), table 11.

⁸The City of Sheridan levy includes only the mill rate for the General Fund. The Sheridan County figure includes levies for the General Fund, the Fair Fund, the Library Fund, and General Welfare and Health.

⁹Wyoming Department of Revenue and Taxation, *Annual Report, Fiscal Year 1974*, Cheyenne, 1974, pp. A-34 and A-36.

¹⁰The remaining four percent would be distributed to Clearmont, Dayton, and Ranchester. The proportion allocated to the City of Sheridan will probably increase based on *1980 Census of Population*.

The change in personal income is approximated by the projected increase in basic and derivative earnings shown in table G-22; it is assumed that they are distributed in the same manner as population and that 90 percent accrues to Sheridan County residents.¹¹

Cigarette tax distributions to all governments in Sheridan County have averaged between \$6.50 (1970 dollars) and \$5.50 (1970 dollars) per capita between 1971 and 1974.¹² There has been a definite downward trend during this period. The total distribution is projected to be \$5.00 (1970 dollars) per capita in 1980 and 88 percent will be allocated to the City of Sheridan and 6 percent to Sheridan County.

Gasoline tax distributions to Sheridan County governments averaged about \$12.50 (1970 dollars) per capita between 1971 and 1973.¹³ This figure declined to about \$9.50 (1970 dollars) in 1974, possibly due to rising gasoline prices and the energy crisis. Higher gasoline prices are certain to continue and they will tend to dampen future growth in consumption. On the other hand, many of the workers will commute to the mines and may consume more gasoline than the average person. Consequently, a compromise figure of \$11.00 (1970 dollars) per capita for the total gasoline tax distribution is projected, with 48 percent allocated to both the City of Sheridan and Sheridan County.

The potential increases in operational expenditures and tax revenues for the City of Sheridan and Sheridan County during 1980 are presented in table G-28. For the North Extension Mine, operational expenditures

¹¹As discussed earlier, the increase in personal income will probably exceed the rise in earnings. Thus, the estimate of the sales and use tax distribution is probably conservative.

¹²Wyoming Department of Revenue and Taxation, *Annual Report, Fiscal Year 1975*, pp. A-37 to A-39.

¹³Budgets for the City of Sheridan and Sheridan County.

for Sheridan County and the City of Sheridan are projected to increase by \$15,700 (1970 dollars) and \$34,700 (1970 dollars), respectively, while the corresponding growth in tax revenues (including the gasoline tax) will be \$8,300 (1970 dollars) and \$12,200 (1970 dollars), respectively. The East Decker Mine will be associated with expenditure increases of \$64,800 (1970 dollars) and \$143,300 (1970 dollars) for Sheridan County and the City of Sheridan. Tax revenues are projected to increase by \$33,700 (1970 dollars) and \$49,200 (1970 dollars), respectively. Taken together, the proposed Decker mines are projected to increase the expenditures of Sheridan County by \$80,500 (1970 dollars) and tax revenues by \$42,000 (1970 dollars) in 1980. The City of Sheridan will experience an increase of \$178,000 (1970 dollars) in expenditures and \$61,400 (1970 dollars) in tax revenue.

The figures in table G-28 show the projected increase in expenditures significantly greater than the growth in tax revenue. Expenditures have been intentionally overestimated while tax revenue projections are very conservative. Further, other nontax revenue--such as fees and licenses--are not included and these sources contributed significantly to the growth in expenditures during recent years. In short, these figures probably represent the worst possible outcome.

The projected increases in operational expenditures and revenues and the cumulative school construction costs for Sheridan School District 2 are presented in table G-29. The projected increase in operational expenditures and school construction costs are based on the assumption that school children due to the proposed Decker mines cannot be accommodated with present resources and that additional staff and buildings must be supplied. During 1973, most Sheridan Schools were at or near

Table G-28
Increase in Government Expenditures and Tax Revenues
City of Sheridan and Sheridan County
1980

| | <u>North Extension Mine</u> | <u>East Decker Mine</u> | <u>Total, North Extension and East Decker Mines</u> |
|------------------------------------------------------------------|-------------------------------------|-----------------------------|-------------------------------------------------------------|
| <u>Sheridan County</u> | | | |
| Increase in operational expenditures (1970 dollars) ^a | \$15,700 | \$ 64,800 | \$ 80,500 |
| Increase in tax revenue (1970 dollars) | | | |
| Local property taxes | 2,500 | 10,400 | 12,900 |
| Sales and use tax distributions | 3,900 | 15,600 | 19,500 |
| Cigarette tax distribution | 100 | 400 | 500 |
| Subtotal | 6,500 | 26,400 | 32,900 |
| Gasoline tax distribution | 1,800 | 7,300 | 9,100 |
| Total, all taxes | \$ 8,300 | \$ 33,700 | \$ 42,000 |
| <u>City of Sheridan</u> | | | |
| Increase in operational expenditures (1970 dollars) ^b | \$34,700 | \$143,300 | \$178,000 |
| Increase in tax revenue (1970 dollars) | | | |
| Local property taxes | 2,100 | 8,500 | 10,600 |
| Sales and use tax distributions | 6,800 | 27,300 | 34,100 |
| Cigarette tax distribution | 1,500 | 6,100 | 7,600 |
| Subtotal | 10,400 | 41,900 | 52,300 |
| Gasoline tax distribution | 1,800 | 7,300 | 9,100 |
| Total, all taxes | \$12,200 | \$ 49,200 | \$ 61,400 |

^aIncludes General Fund expenditures less Federal Revenue Sharing projects.

^bIncludes General Fund expenditures (less Federal Revenue Sharing projects), Welfare and Health Funds, Library Fund, and the Fair Fund.

Table G-29

Projected Potential Increase in Operational Expenditures and
Revenues, and School Construction Costs
Sheridan School District 2
1980

| | <u>North Extension Mine</u> | <u>East Decker Mine</u> | <u>Total, North Extension and East Decker Mines</u> |
|----------------------------------------------------------|-------------------------------------|-----------------------------|-------------------------------------------------------------|
| Increase in operational expenditures (1970 dollars) | \$ 73,900 | \$ 306,900 | \$ 380,900 |
| Increase in revenue (1970 dollars) | | | |
| Local property taxes | 13,400 | 54,600 | 68,000 |
| State aid | 38,300 | 159,000 | 197,300 |
| Total | 51,700 | 213,600 | 265,300 |
| School construction costs (1970 dollars) ^a | \$372,000 | \$1,544,000 | \$1,916,000 |

^a Cumulative to 1980.

capacity.¹⁴ Based on the relatively constant number of births to Sheridan County residents since 1970, a good prediction of enrollment later in the decade, it appears unlikely that there will be excess capacity in the present facilities.

Operational expenditures are projected to average \$795 (1970 dollars) per ADM (Average Daily Membership), approximately equal to the actual expenditures in Sheridan School District 2 during the 1973-74 school year.¹⁵ There is evidence that the cost per pupil tends to decrease with enrollment growth for school districts in Wyoming.¹⁶ Therefore, the projected increases in operational expenditures are probably on the high side.

Property tax revenues are projected by applying the 1974-75 levy of 47.66 mills for District 2 to the increase in assessed valuation estimated earlier, which is assumed to be entirely within the school district. The amount of state aid will depend on Wyoming's legislature and their funding of the Foundation Program. During the 1973-74 school year, state aid averaged \$412 (1970 dollars) per ADM for Sheridan District 2.¹⁷ This figure is used for the 1980 projection. School construction costs are projected to average \$4,000 per ADM.¹⁸ The

¹⁴*Capital Facilities Study, Powder River Basin*, p. 26.

¹⁵Wyoming Department of Education, *Wyoming Public School Fund Accounting and Reporting, 1973-74*, Cheyenne, 1974, pp. 46-47. Average Daily Membership is a standardized measure of enrollment. During 1973, it averaged about 95 percent of total enrollment.

¹⁶*Capital Facilities Study, Powder River Basin*, pp. 67-69.

¹⁷*Wyoming Public School Fund Accounting and Reporting, 1973-74*, p. 46.

¹⁸Wyoming Department of Education, "An Impact Report on Public School Facility Needs," Cheyenne, 1974, mimeo., 1974, p. 5.

projected construction costs are the cumulative totals for the 1976-1980 period.

The north Extension Mine is projected to increase school operational costs by \$73,900 (1970 dollars) with a corresponding increase of \$51,700 (1970 dollars) in revenue during 1980. Operational expenditures and revenues associated with the East Decker Mine are projected to be \$306,900 (1970 dollars) and \$213,600 (1970 dollars), respectively, in 1980. These figures suggest that, for both mines, the increase in operational expenditures will exceed additional revenues. However, as with the other estimates of government finances, these projections utilize very conservative assumptions and probably represent the least favorable outcome.

The construction of additional school facilities is projected to total \$372,000 (1970 dollars) for the North Extension Mine and \$1,544,000 (1970 dollars) for the East Decker Mine in 1980. The financing of these facilities is likely to be a serious problem because the Sheridan School District has bonded indebtedness of almost 92 percent of its legal bonding capacity.¹⁹ As of June 30, 1974, there was less than \$207,000 (1970 dollars) in unobligated bonding capacity remaining. The projected growth in taxable valuation will probably not sufficiently increase the legal bonding capacity to allow for the financing of the projected construction expenditures.

The additional costs of new capital items for the local governments in Sheridan County are not projected. Many of the existing facilities are already overcrowded or inadequate.²⁰ But, these are problems which

¹⁹ *Wyoming Public School Fund Accounting and Reporting, 1973-74*, p. 76.

²⁰ *Capital Facilities Study, Powder River Basin*, pp. 20-23

currently exist and are not directly attributable to the proposed Decker mines. The plight of the Sheridan sewer system, however, has received significant public attention and is discussed in detail.

The Sheridan sewage treatment plant was updated in 1966 and can accommodate, with current standards, a population of up to 16,000 persons. Thus, the proposed Decker mines will not, by themselves, cause a sufficient increase in population to require expansion of the treatment plant. But, there is currently some effluent being released into Goose Creek and the Environmental Protection Agency has required this to be eliminated by 1985. The construction of a new plant with the capacity of serving 20,000-25,000 residents and meeting the EPA requirements has been estimated to be between \$1,800,000 and \$2,000,000 (current dollars).²¹ Even if 75 percent of this amount were financed by federal funds, Sheridan does not have the bonding capacity necessary to issue new bonds.²² If this problem can be circumvented, revenue bonds could be issued with redemption and interest payments derived from higher sewer charges. In total, a new sewer treatment plant would cost Sheridan sewer customers about \$3.90 (current dollars) per person per year.²³

²¹National Commission on Water Quality, *Draft Final Report of the Yellowstone Regional Assessment Study*, vol. 1, Washington, D.C., 1975, pp. 144-151.

²²*Ibid.*

²³*Ibid.*

Statistical findings and projection methodology

Employment and earnings were projected with a variant of economic base analysis. This procedure was developed at the Bureau of Business and Economic Research, University of Montana, and has been used in other studies of coal-related development in Montana.¹ It may be summarized as follows: employment and earnings due to coal-related activities are viewed as additions to exogenous (basic) industries. A "multiplier" is then used to estimate the associated increase in endogenous (derivative) earnings. Average and FTE earnings per derivative jobs were projected separately and then combined with the projected (total) derivative earnings to obtain the number of new derivative jobs.

The multiplier

The relationship between the basic and derivative industries forms the foundation of the methodology and will be discussed in detail. A small regional economy may be divided into endogenous and exogenous sectors and the former is conceived to be functionally dependent on the latter. Empirically, the exogenous sector consist of export industries, such as agriculture, mining, selected manufacturing classifications, railroads, certain types of construction, and the federal government. On the other hand, the endogenous (or derivative) sector includes the trade, services, and other industries serving the local population.

¹Paul E. Polzin, *Water Use and Coal Development in Eastern Montana*, Bureau of Business and Economic Research, University of Montana, 1974, pp. A-1 to A-15. _____ "An Income Model for the State of Montana," Bureau of Business and Economic Research, University of Montana, unpublished manuscript, 1975.

The relationship between the basic and derivative sectors may be summarized in the following equation

$$(1) \quad D = a + bX + CF.$$

Where D is total derivative earnings, X is total nonagricultural basic earnings, and F is gross farm receipts. The model is phrased in terms of earnings rather than employment because this version is less likely to have specification errors, given the limited data available for counties. Farm receipts rather than farm earnings were used because the studies cited earlier concluded that it more accurately represented determinants of spending patterns in agriculture.

The basic and derivative sectors for Big Horn and Sheridan counties are shown in tables G-30 and G-31. The sector definitions are in terms of industries and follow the Standard Industrial Classification (SIC) and the classification used by the U. S. Bureau of Economic Analysis. Entire industries were classified as either basic or derivative on an a priori basis. There was no attempt to empirically categorize industries into basic and derivative components. When the nature of an industry was in doubt, a higher degree of disaggregation was used, i.e., 3-digit instead of 2-digit, or the entire industry was placed in the derivative sector.

Earnings for nonagricultural industries and gross farm receipts were taken from the U. S. Bureau of Economic Analysis' estimates of *Personal Income by Major Sources* and *Farm Income and Expenditures*. This source provides figures for broad industrial categories on an annual basis between 1965 and 1973. Unpublished data provided by the Montana Department of Labor and Industry, Employment Security Division, and *County Business Patterns* were used to derive values for the 2- and 3-digit industries.

Table G-30

Basic and Derivative Industries
Sheridan County, Wyoming

| Basic Industries | | Derivative Industries | |
|--------------------------------------------------------|----------|--------------------------------------------------------------------|----------|
| Industry | SIC Code | Industry | SIC Code |
| Agriculture | -- | | |
| Mining | 10-14 | | |
| Construction | | Construction | |
| Building construction | 15 | Special trade contractors | 17 |
| Heavy construction | 16 | | |
| Manufacturing | | Manufacturing | |
| All other manufacturing | 21-39 | Food and kindred products | 20 |
| | | | |
| Transportation, communication, and public utilities | 40 | Transportation, communication, and public utilities | |
| Railroads | | All other transportation, communication and public utilities | 41-49 |
| | | | |
| Services | | Wholesale and retail trade | 50-59 |
| Hotels, motels, and rooming houses | 70 | Finance, insurance, and real estate | 60-67 |
| | | Services | |
| | | All other services | 71-89 |
| Federal government | | | |
| Federal civilian | -- | State and local governments | -- |
| Federal military | -- | | |
| | | All other industries | -- |

Table G-31

Basic and Derivative Industries
Big Horn County, Montana

| <u>Basic Industries</u> | <u>SIC Code</u> | <u>Derivative Industries</u> | <u>SIC Code</u> |
|--------------------------------------------------------|-----------------------|---------------------------------------------------------------------|-----------------|
| Agriculture | -- | | |
| Mining | 10-14 | | |
| Construction | | Construction | 17 |
| Building construction | 15 | Special trade contractors | |
| Heavy construction | 16 | | |
| Manufacturing | | Manufacturing | 27 |
| All other manufacturing ^a | 204,206 227,24,367 | Printing and publishing | 327 |
| | | Concrete products | |
| Transportation, communication, and public utilities | 40 | Transportation, communication, and public utilities | |
| Railroads | | All other transportation, communication, and public utilities | 41-49 |
| | | Wholesale and retail trade | 50-59 |
| | | Finance, insurance, and real estate | 60-67 |
| Services | | Services | 71-89 |
| Hotels, motels, and rooming houses | 70 | All other services | |
| Federal government | | State and local governments | -- |
| Federal civilian | -- | | |
| Federal military | -- | All other industries | -- |

^a Includes industries not in continuous operation between 1965 and 1973.

These sources provided a time series of nine observations, 1965 through 1973, for derivative and nonagricultural basic earnings and gross farm receipts for Big Horn and Sheridan Counties. The number of observations was limited by the availability of data for Sheridan County.

The parameters of the model--"a," "b," and "c," in equation (1)--were estimated with regression analysis. A summary of the findings are presented in table G-32. Alternative specifications were estimated and it was found that gross farm receipts that lagged one period gave the best results.²

The regression coefficients on nonagricultural basic earnings and gross farm receipts are statistically significant according to accepted social science criteria. A test for autocorrelation of the residuals could not be performed because of insufficient observations. (Annual data in current dollars are a prime candidate for autocorrelation.) A first order auto regressive model was estimated for alternative values of ρ_0 . The coefficient on nonagricultural basic earnings was found to be somewhat sensitive to the specification of the lagged error term; but, the alternative estimates were not statistically different from those shown in table G-32.

The coefficient of .80 for nonagricultural basic earnings suggests that derivative earnings will increase by \$0.80 for each \$1.00 increase in mining or railroad earnings. The relatively small number of observations

²Gross farm receipts for 1964 were estimated from U. S. Bureau of the Census, Census of Agriculture, 1964, Statistics for the State and Counties, *Montana and Wyoming* (U. S. Government Printing Office, Washington, D. C.), 1972, table 6. Montana Department of Agriculture and Statistical Reporting Service-U.S.D.A. *Montana Agricultural Statistics*, Vol. XII, p. 14.

Table G-32

Summary of Regression Analysis
Big Horn-Sheridan Impact Area

| <u>Dependent Variable</u> | <u>Constant</u> | <u>Nonagricultural Basic Earnings</u> | <u>Gross Farm Receipts</u> | <u>-2^a R</u> | <u>N</u> | <u>F(2,6)</u> |
|-------------------------------|-----------------------------|-------------------------------------------|----------------------------------------|-----------------------------|----------|-------------------|
| Derivative Earnings | 3,352.4 (4,507.6) 0.7 | .8014 (.3522) 2.275 ^b | .4910 (.1566) 3.135 ^b | .903 | 9 | 38.3 ^b |

Note: Beneath each coefficient are its standard error and "t" ratio.

^aCorrected for degrees of freedom.

^bSignificant at the .05 level.

and large standard error do not lend confidence to this estimate. But, it does "make sense" in light of other findings. Specifically, it is between the 1.45 estimated for seven southeastern Montana counties, which include Billings and Miles City, and the .31 estimated for three rural Montana counties--Big Horn, Rosebud, and Powder River Counties.³ One would expect the propensity to spend locally the Big Horn-Sheridan impact area to be greater than the three rural counties. The City of Sheridan is much larger than Hardin and Forsyth and no doubt attracts much of the retail business from southern Big Horn County. On the other hand, it offers nowhere near the diversity and depth of retail, wholesale, medical, and financial services offered by a city the size of Billings. Finally, there is evidence that the behavioral parameters underlying this specification, such as the propensity to spend locally, are relatively stable from one period to the next; nine years of data may be sufficient to establish valid estimates.⁴

The value of .80 was used to project the increase in derivative earnings due to changes in mining and railroad earnings. The new activity due to the Decker mine proposals will probably not, by themselves, be sufficient to increase the aggregate propensity to spend locally. No doubt some new businesses will be established. They will, however, probably be similar to those already existing in the area.

The increase in derivative earnings due to construction activity was projected to be one-half of the per dollar impact of permanent employees. In other words, \$1.00 of construction earnings will lead to \$0.40 of

³Paul E. Polzin, *Water Use and Coal Development in Eastern Montana*, p. A-6.

⁴Paul E. Polzin, "An Income Model for the State of Montana," pp. 14-16.

derivative earnings. This parallels the approach of other studies of the economic impact of coal development.⁵

Earnings per worker

The underlying relationship between the basic and derivative sectors is in terms of aggregate spending patterns and dollars. Projections of earnings per worker in basic and derivative industries were used to convert the manpower requirements in the coal-related industries into export earnings and then reconvert the estimated increase in derivative earnings back into derivative employment. That is, the average earnings per worker in each of the coal-related industries was projected. This was used to estimate the total increase in basic earnings, which when multiplied by the values discussed earlier and combined with the projected decline in gross farm receipts yielded the projected increase in derivative earnings. Average and FTE derivative employment was derived by dividing total derivative earnings by average and FTE earnings per derivative worker.

The projected earnings in constant 1970 dollars for coal miners, railroad, and construction workers are shown in the table G-23. The 1975 figures were derived from information provided by the Decker Coal Company, the Burlington Northern Railroad, and the Montana Employment Security Commission. These values differ slightly from those used in an earlier study because they are based, to some extent, on past data; while the earlier figures were derived before actual information was available.⁶

Projected earnings per worker in the basic industries were derived by applying projected national rates of change for each industry to the

⁵Paul E. Polzin, *Water Use and Coal Development in Eastern Montana*, p. 128.

⁶Paul E. Polzin, *Water Use and Coal Development in Eastern Montana*, p. A-9.

Table R-33

Annual Earnings per Worker in Coal-Related Industries, by Industry
1975 and Projected 1976 to 2000
Big Horn-Sheridan Impact Area

(In 1970 Dollars)

| | <u>1975</u> | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> | <u>1985</u> | <u>2000</u> |
|--------------|-------------|-------------|-------------|-------------|-----------------|-----------------|-----------------|-----------------|
| Coal mining | \$13,500 | \$13,810 | \$14,128 | \$14,453 | \$14,785 | \$15,126 | \$16,986 | \$23,939 |
| Railroad | 12,400 | 12,722 | 13,053 | 13,393 | 13,741 | 14,098 | 15,944 | 22,957 |
| Construction | 12,000 | 12,324 | 12,657 | 12,998 | -- ^a | -- ^a | -- ^a | -- ^a |

Sources: [1975] Burlington Northern Railroad, Decker Coal Company, and Montana Employment Security Commission, unpublished data. [Rates of Changes] U.S. Bureau of Economic Analysis, National Projections by Industry, Series E, unpublished data, 1973.

^aNo projected construction employment.

1975 values. Implicit in this procedure is the assumption that these workers will receive (real) wage increases at the same rates as their national counterparts. There is, however, no provision for increases in their productivity. It is assumed that productivity is constrained by the technology embodied in the capital and equipment at the time of installation and that it remains constant throughout the life of the mine.

The average and FTE earnings per derivative worker are presented in table G-34. The 1980 average earnings was derived from earlier projections for Montana. In light of the scale of projected development and the characteristics of the impact area, the earnings per derivative worker should lie between the projected values for the three- and seven-county areas in Montana. That is, the characteristics of the Sheridan-Big Horn area, taken as a whole, are less rural than the three-county area, but nowhere near as urban as the seven-county area, and the Decker mine proposals represent a significant, but not overwhelming impact on the local labor market. The rate of change between 1972 and 1980 is far greater than that which would have occurred in the absence of the Decker mine proposals; it represents the transformation of the endogenous labor market from one of excess supply to a situation of potential excess demand. The annual projections for 1976 to 1980 are only guesses; they reflect the fact that labor market pressures, and the largest increase in earnings, will probably be greatest between 1977 and 1980, when most of the new primary jobs are created.

After 1980, the change in average earnings per derivative worker approximates the rate projected by OBERS for this area.⁷ This implicitly

⁷U. S. Water Resources Council, *1972 OBERS Projections*, Washington, D.C. 1972, Volume 2, pp. 194-196 and 304-305. U. S. Bureau of Economic Analysis, Regional Economic Information System, 1974, unpublished data.

TABLE G-34

Average and FTE Earnings per Derivative Worker and Average Annual Hours of Work
1972 and Projected 1975 to 2000
Big Horn-Sheridan Impact Area

| | <u>1972</u> | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> | <u>1985</u> | <u>2000</u> |
|-----------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | | | | | | | | |
| "Average" derivative worker (1970 dollars) | \$5,020 | \$5,600 | \$5,900 | \$6,500 | \$7,180 | \$ 7,470 | \$ 8,530 | \$12,850 |
| Average annual hours of work | 1,478 | 1,456 | 1,450 | 1,444 | 1,439 | 1,433 | 1,396 | 1,312 |
| FTE derivative worker (1970 dollars) | 6,790 | 7,830 | 8,140 | 9,000 | 9,980 | 10,430 | 12,220 | 19,590 |

Sources: (1972 Earnings per worker) U.S. Bureau of Economic Analysis, Regional Economic Information System, Washington, D.C., unpublished data, 1974. (Annual hours) U.S. Bureau of the Census, Census of Population: 1970, Detailed Characteristics, Final Report, PC(1)-D28, Montana, and PC(1)-D52, Wyoming, Washington, D.C., 1972, table 185. Montana Department of Labor and Industry, Montana Labor Market, Supplement II. Ronald E. Kutscher, "Projections of GNP, Income, Output, and Employment," Monthly Labor Review, Volume 96, No. 12 (December 1973), p. 38.

assumes that no further coal development takes place. This may be unrealistic, but it is appropriate for the analysis of only the Decker mine proposals.

The annual hours of work was estimated for 1970. It was then projected into the future using national projections for individual derivative industries. The implicit assumption is that the increased labor market pressures in the Sheridan-Big Horn impact area do not alter the trend toward fewer annual hours in derivative industries.

Agriculture

The North Extension and East Decker mines will remove some agricultural land from production and reduce the gross farm receipts in the area. This, in turn, will reduce derivative earnings. According to the regression analysis presented in table G-32, derivative earnings in the impact area will decline by \$0.49 for each \$1.00 decrease in gross farm receipts.

The Decker Coal Company plans to fence and remove from agricultural production for the life of the projects approximately 3,158 acres for the North Extension Mine and about 3,170 acres for the East Decker Mine. At present, most of this land is used for grazing. There are, however, between 400 and 500 acres of flood irrigated hay land on the site of the North Extension Mine.

During 1973, gross farm marketings averaged about \$8.60 (1970 dollars) per acre for all agricultural land in Big Horn County.⁸ This figure

⁸U. S. Bureau of the Census, Census of Agriculture, 1969, Volume 1. Area Reports, Part 38, *Montana*, Section 2. County data, U. S. Government Printing Office, Washington, D.C., 1972, p. 17. Montana Department of Agriculture and Statistical Reporting Service--U.S.D.A., *Montana Agricultural Statistics*, Volume XV, Helena, 1974, p. 13.

includes cropland and other irrigated land and probably overstates the revenue per acre of the land to be affected by the Decker mines. Nevertheless, to allow for possible increases in the (real) price of agricultural products and potential declines in the productivity of adjacent acreage, it will be assumed that the land would have averaged \$15.00 (1970 dollars) per acre per year in gross farm receipts. Further, it is assumed that all 3,158 acres associated with the North Extension Mine are taken out of agricultural production during 1976 and 3,170 acres associated with the East Decker Mine are removed in 1978, when coal production is scheduled to begin. Thus, the North Extension Mine is projected to decrease gross farm receipts by \$47,370 (1970 dollars) per year. The corresponding figure for the East Decker Mine is projected to be \$47,550 (1970 dollars). In light of the statistical findings reported in table G-32, the decline in derivative earnings will not occur until the year following the decrease in gross farm receipts.

The decline in agricultural employment is uncertain and has not been projected. It depends, among other things, on whether entire ranch units are affected or production is simply transferred to a different area.

Coal-related development and the Montana tax system

Four major taxes of the Montana tax system affect the operations of strip coal mines in Montana. Two of the taxes are based directly on the gross value of the coal, the Coal Mines License Tax and the Resource Indemnity Trust Tax. The Corporation License Tax is an income tax based on the net income of the corporate operation.¹ The fourth tax is the property tax which is levied against real and personal property; rights to enter land for digging, prospecting, or exploration, and the gross proceeds of coal mines.

This supplement will look at each of these taxes in some detail, placing particular emphasis on the mechanisms in the tax system for transferring tax monies to locally impacted, coal development areas.

Coal mines license tax²

The Coal Mines License Tax is a severance tax on the gross value of coal mined in the state. The tax is levied against coal producers and the rates are based on the BTU rating (heat content) of the coal and the contract sales price. The current rate schedule is as follows:

| Heating Quality (BTUs/lb of Coal) | <u>Surface Coal Mines</u> | <u>Underground Coal Mines</u> |
|-----------------------------------------|----------------------------------------------------|---------------------------------------------------|
| Under 7,000 | \$.12/ton, or 20% of value, whichever is higher | \$.05/ton, or 3% of value, whichever is higher |
| 7,000-8,000 | \$.22/ton, or 30% of value | \$.08/ton, or 4% of value |
| 8,001-9,000 | \$.34/ton, or 30% of value | \$.10/ton, or 4% of value |
| Over 9,000 | \$.40/ton, or 30% of value | \$.12/ton, or 4% of value |

¹The incomes of individuals are also taxed by the Montana Individual Income Tax, but, since most coal producers are corporations, this tax is not discussed in this section. However, the increase in Individual Income Tax revenues resulting from the additional incomes of construction workers and coal miners working in Montana, are estimated in the impact section.

²Revised Codes of Montana (RCM) 1947, Title 84, Chapter 13.

Each mine operator must file a statement with the Montana Department of Revenue for each calendar quarter of operation indicating the tonnage produced, the contract sales price, the BTU rating of the coal, and a computation of the tax due. In computing the tax, the first 5,000 tons of coal produced each quarter are exempt. The quarterly report and amount of tax payment must be sent to the Department of Revenue within 30 days after the end of the quarter. A penalty for failure to file, or late payment, of 10 percent can be levied as well as interest of 1 percent per month.

"Contract sales price" is defined to mean either: (1) the price of the coal extracted and prepared for shipment, F.O.B. mine, excluding that amount charged by the seller to pay taxes paid on production; or (2) the price imputed by the Department of Revenue where the coal is not sold under an arms-length agreement.

"Taxes paid on production" is defined as any tax paid to federal, state, or local governments, upon the quantity of coal produced as a function of volume or value. Property and income taxes are specifically excluded from this category.

In cases where the coal producer also processes the coal or transfers the coal to a parent corporation, or other subsidiary, at less than an arms-length transaction, the Department of Revenue will impute a price which approximates market values. The Department may request federal income tax and sales contract data from the producer.

The Montana Bureau of Mines and Geology is assigned the task of determining the BTU content of coal samples supplied by the producer.

At least one sample per year is required by law although the Bureau may request additional samples.

The 1975 Montana Legislature made sweeping changes in both the method of computation and distribution of proceeds from this tax. Prior to July 1, 1975, this tax applied strictly to strip mines and the rates per ton were based on BTU content, ranging from \$.12 to \$.40 per ton. Three cents per ton of the tax were returned to the county where the mine was located and the remainder went into the state's general fund.

Effective July 1, 1975, the distribution of the Coal Mines License Tax is as follows:

| | |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| \$.03/ton, or 4% of the tax revenue, whichever is higher | -- to the county from which the coal was mined for such purposes as the county government may determine. After December 31, 1979, the rate changes to \$.03/ton, or 3-1/2% of the tax. |
| 27.5% of the tax revenue | -- to a local impact and education trust fund account. After July 1, 1979, the rate changes to 35% of the tax. |
| 10% of the tax revenue | -- to a coal area highway improvement account until July 1, 1979. |
| 10% of the tax revenue | -- to the earmarked revenue fund for state equilization aid to public schools of the state. |
| 1% of the tax revenue | -- to a county land planning account until December 31, 1979. |
| 2-1/2% of the tax revenue | -- to an alternative energy research development account. After December 31, 1979, the rate changes to 4%. |
| 2-1/2% of the tax revenue | -- to the sinking fund for renewable resource development bond account. |

2-1/2% of the tax revenue -- for the acquisition of land for state parks, recreational areas, state monuments or state historical sites. After July 1, 1979, the rate is increased to 5% and the funds are limited to park acquisitions.

The remaining 40% -- to the general fund.

The tax revenue accumulated in the coal area highway improvement fund will be transferred to the Department of Highways to improve primary and secondary highways in the designated area.

The governor has appointed a seven-member coal board which will administer the local impact and education trust fund account. The board will make grants to local governments (counties, cities, and towns and school districts) and to state agencies to assist the local governments in providing adequate governmental services and facilities needed as a direct consequence of coal development. The Department of Community Affairs is assigned the task of designating counties, towns, and school districts which have at least 10 percent population increase during any three years since 1972, as a result of coal development. The coal board must then establish a priority for these areas and give 50 percent of all grants to these high growth areas.

By law, the coal board may only make grants up to 7/11 of the revenue paid into the local impact and education trust fund until June 30, 1979. After that date, up to 3/7 of the revenue to that account may be expended for grants. The investment income from the trust account is earmarked for the education equalization fund.

The revenue accumulated in the county land planning account will

be distributed by the Department of Community Affairs to counties on the basis of the county's percentage of total land area of the state and the percentage of total population of the state.

Resource indemnity trust tax³

The Resource Indemnity Trust Tax is a tax placed on the extraction of nonrenewable resources in the state to provide a trust fund account for repairing damage to the environment caused by resource extraction. The tax is levied against business entities extracting nonrenewable resources, including coal, and is based on the value of the product extracted. Each mine operator must file with the Department of Revenue a statement by March 31, indicating the gross yield and value of the minerals at the time of extraction during the previous calendar year. The annual tax to be paid at the time of filing is \$25 plus 0.5% of the gross value of the mineral extracted, if in excess of \$5,000.

All receipts from the Resource Indemnity Trust Tax will be invested by the State Board of Investments until the principal and interest in the trust account reaches \$10,000,000. At that point, the net earnings may be appropriated and expended until the account reaches \$100,000,000. Thereafter, the net earnings and receipts of the tax may be appropriated by the legislature and expended to "improve the total environment and rectify damage thereto."

This tax was enacted by the 1973 legislature and first applied to mineral production in calendar year 1973. The balance of the trust account as of August 31, 1975, was \$3,291,879, so it will take several

³RCM, 1947, Title 84, Chapter 70.

years to reach a balance of \$10,000,000 where subsequent net earnings of the account will be available for expenditure.

Corporation license tax⁴

The Corporation License Tax is an income tax levied against corporations for the privilege of doing business in the state of Montana. Corporate net income is determined in a manner similar to that of the federal corporate income tax; allowable deductions for operating expenses and depreciation are subtracted from gross income to derive taxable income. Montana taxes only the income derived from business conducted in Montana and the statutes provide procedures for the segregation of income within and without the state.

The tax rate is 6.75 percent of the net income derived in Montana with a minimum of \$50. The tax return and payment must be filed by the 15th day of the fifth month after the close of the corporation's fiscal year.

Receipts from the Corporation License Tax are distributed to three state funds: 64 percent to the general fund, 25 percent to the education equalization fund, and 11 percent to the sinking fund for bond retirement (long range building program).

Property taxes

Property taxes are levied by the state, counties, cities and towns, school districts, and special districts against the holders of real and personal property, rights to enter land for digging, prospecting, or exploration, and the gross proceeds of coal mines. The responsibility

⁴RCM, 1947, Title 84, Chapter 15.

for equitable assessment of all property in the state lies with the Department of Revenue. The county governments serve as the tax collector and agent for the other levels of government.

Real and personal property

The machinery, equipment, and real estate (land and buildings) of coal mines are included in this category and subject to property taxation. Real and personal property in the state is assessed at 40 percent of its full cash value. The assessed valuation is then reduced by the classification system in the Montana laws.⁵ Most nonagricultural real and personal property is included in Class 4 which is taxable at 30 percent of its assessed value. An exception would be pollution control equipment which is now classified in Class 7 and taxed at 7 percent of its assessed valuation.

Certain new industrial property may receive preferential tax treatment by being classified as Class 7 property for the first three years and taxed at 7 percent of assessed valuation rather than 30 percent under Class 4. To achieve this status the new industrial facility must apply to the Department of Revenue and meet the definition under the law:

New industry shall mean any person, corporation, firm partnership, association, or other group which establishes a new plant or plants in this state for the operation of a new industrial endeavor, as distinguished from a mere expansion, reorganization, or merger of an existing industry or industries. Provided, however, that the industrial property shall be limited to industries that manufacture, mill, mine, produce, process or fabricate material, or do similar work in which capital and labor are employed and in which materials unserviceable in their natural state are extracted, processed or made fit for use or are substantially altered or treated so as to create commercial products or materials; . . . and in no

⁵RCM, 1947, Sections 84-301 and 84-401.

event shall the term new industrial property be included to mean property used by retail or wholesale merchants, commercial services of any type, agriculture, trades or professions. . .⁶

The 1975 Legislature narrowed this definition further by excluding new industrial property which will create an adverse impact on existing, state, county, or municipal services. The Department of Revenue must develop regulations for the determination of what constitutes an adverse impact taking into consideration the number of people to be employed and the size of the community in which the location is contemplated. If the Department of Revenue must hold a hearing if it rejects an application for Class 7 status on these grounds. At this time, the local taxing authority may waive its objection to Class 7 status if the industry agrees to prepayment of taxes sufficient to satisfy tax requirements created by the location and construction of the facility.

The Department of Revenue has taken the position that firms who have previously operated coal mines in Montana cannot be subsequently classified as a new industrial facility by opening a new mine. This point is currently under litigation. The new requirement for determination of adverse effect has not been exercised as of yet.

Rights to Enter Land

The property tax is also levied against "rights to enter land for digging, prospecting, or exploration." Since these rights are intangible in nature and there are no legally prescribed means of measuring the value of such rights, the Department of Revenue has appraised the value on a per acre basis with average values by county ranging from \$0.20 to

⁶RCM, 1947, Section 84-301, Class 7(a).

\$7.50 an acre. These rights are included in Class 1 and are taxable at their full assessed value.

Gross Proceeds

The 1975 Legislature excluded coal mines from the Net Proceeds Tax of Montana and passed legislation to include the gross proceeds of coal mines as property subject to property tax mill levies.⁷ Each person or firm engaged in coal mining must file a statement with the Department of Revenue by March 31st indicating the gross yield of coal and its value for the preceding calendar year. The "contract sales price" as defined for the Coal Mines License Tax in Section 84-1313 will be used as the valuation of the coal production for the year. By July 1 the Department of Revenue must transmit the valuation of the gross proceeds to the county assessor who enters the valuation on the tax roles of the jurisdiction where the mine is located. The gross proceeds of underground coal mines are classified in Class 3 and taxed at 33-1/3 percent of the assessed valuation. Gross proceeds of strip mines are included in Class 10 and taxed at 40 percent of the assessed valuation.

Property Tax Computation and Collection

The taxable values determined in the previous paragraphs are totaled and multiplied by the mill levy rate for each taxing jurisdiction in which the property is located. The county treasurer notifies the taxpayers of the amount due, collects the tax, and transfers the amounts levied by the state and lower governmental units.

Under certain circumstances the county commissioners of a county in which a major new facility is planned may require the prepayment of

⁷RCM, 1947, Sections 84-1320 to 84-1324.

three times the estimated property tax due the year the facility is completed.⁸ A major new industrial facility is defined as a manufacturing or mining facility which will employ, on an average annual basis, at least 100 people in construction or operation of the facility and which will create a substantial adverse impact on existing state, county, or municipal services. Payment need not be all at one time, but only in the amounts needed from time to time by request of the county commissioners. Property will be taxed during the first three years and thereafter, except that 1/5 of the amount prepaid will be allowed as a credit against property taxes in each of the first five years after the start of productive operation.

Aid to Impacted Communities

Two mechanisms in the state tax system are designed to help communities faced with rising government due to industrial development. First, the state education equalization fund is designed to channel funds from school districts with excess financing to districts with deficits. Secondly, the distribution of the funds collected by the Coal Mines License Tax has been modified to channel a portion of the tax receipts back to the communities and counties impacted by coal development. As mentioned in a previous section, 4 percent of the Coal Mines License Tax revenue will be returned to the county from which the coal was mined to be used for such purposes as the county government may determine. An additional 27-1/2 percent of the tax revenue will be channeled back to impacted areas in the form of grants to assist local governments in providing adequate levels of public services and education. Ten percent

⁸RCM, 1947, Section 84-41-105.

of the tax revenue will be used by the State Highway Department for the improvement of highways in coal development areas of the state. Also, recent changes in the state's tax laws allowing counties to require industrial firms to prepay property taxes in certain cases may help many counties over mine and plant construction periods where demands for public services increase rapidly but tax revenues lag far behind.

Description of the Existing Environment

Introduction

A study of social structure and social services was conducted in the Sheridan-Decker area in the summer of 1974. Emphasis was directed toward Sheridan where most Decker employees currently live. A probability (or random) sampling method was selected to gather information from a representative cross section of Sheridan's residents. To standardize and quantify information most readily, a questionnaire was administered in face-to-face contacts with the randomly selected respondents. In addition, personal interviews were arranged with various agency personnel, politicians, businessmen and other informed people in and around Sheridan to obtain in-depth data on various dimensions of social impact. A description of the research methodology is located in the section of Appendix G entitled "Sampling and Survey Procedures " (p. G-176).

Setting

Located at the base of the Big Horn Mountains, Sheridan is a very attractive place with many trees, large old houses, clean and well-kept streets, and a tradition of low cost housing and rent. It is a traditional, conservative town that is sometimes described by its residents as WASPish, class conscious, and cliquish.

Sheridan is a favorite retirement town for many of the rural people in the area. More than a quarter of its residents are age 60 and over, and nearly all of these older people are retired. The great majority of the retired people in Sheridan own their homes and live in middle-class sections of town.

Until recently the population of Sheridan had remained almost the same since the 1920's although the population of Sheridan County had

dropped since then. In the 1910's and 20's there was large-scale underground mining of coal in Sheridan County and there were several small mining towns associated with the mines, each with a population of three or four thousand. At various times Sheridan has had a sugar beet plant, a flour mill, and a brewery; all of these have gradually disappeared.

Our survey revealed that Sheridan's population (10,856 in 1970) is now around 13,000. The county assessor's figures indicate that the county's population has increased by 4,200 since 1970.* Apparently, about half of this increase has occurred in the city of Sheridan.

The population increase appears to have been caused principally by people who have been attracted to Sheridan by actual or hoped-for jobs in the coal industry. In fact, the latter influx became so much a concern that last autumn the local employment office publicized a "Don't come!" message to all who were inclined to come to Sheridan in hopes of finding a job. The message has apparently not stopped such influx. The bulk of Sheridan's population increase therefore consists of younger people. Many of these younger people are taking any job they can find in order to be around in the event that coal industry (especially Decker and Texaco) jobs open up sometime soon. Others stay for a short time and move on. There appears to be little other outmigration at present. Population losses tend to be due to deaths of older people.

Over 80 percent of Sheridan's residents live in permanent single family houses. About 12 percent live in apartments, 4 percent in mobile homes. In addition to the approximately 200 mobile homes in Sheridan,

*In comparing this figure with the much lower 1974 census estimate used in the population section of this report, it should be noted that this figure is supported by other ongoing estimates of population change made by such knowledgeable locals as employment and health agency personnel.

more than 100 are located within a few miles of town. Mobile homes are not new to Sheridan, but they have been much more in evidence in the past few years. There has been little home or apartment construction since World War II, an important factor in accounting for both the general housing shortage and the addition of mobile homes.

For a long time a convenient stopping place for travelers, Sheridan has recently been attracting increasing numbers of itinerant job seekers. Besides the new job seekers who (along with more established locals) wish to be on hand when Decker starts hiring workers for its expanded operations, recent immigrants include some who are employed at Gillette and others who work for Texaco in Johnson County.

Fully two-thirds of Sheridan's residents have been there much or all of their lives. Approximately 6 percent of its adults have resided there for less than one year, 11 percent for less than three years, and 21 percent for less than five years.

Sheridan is a regional shopping center, serving many rural people in northeastern Wyoming and southeastern Montana. The occupations of heads of households are what one would expect in a shopping and general service center of a sparsely populated area. About three out of every ten heads of households are in the professional/managerial/supervisory category and four out of ten in blue-collar and white-collar occupations.

Residents of Sheridan are oriented much more toward Billings than toward Casper or Cheyenne. When it comes to seeking better, more varied, or more specialized shopping facilities, health services, and the like, they usually go to Billings.

Mining was a traditional activity in the Sheridan area for many years.

In the past few years, strip mining has come into prominence and has now superseded the traditional deep mining.

In the order of their appearance, the principal topics covered in the remainder of this part of the report are Quality of Life, The People, Housing, Water and Sewage, Transportation, Schools, Recreation, Public Safety, Social Services, and Health Services.

Quality of Life and Social Values

Many of the people we interviewed described themselves as WASPs and the atmosphere of Sheridan as WASPish. When they talked this way, they were neither bragging nor complaining; rather, they were being matter-of-fact. The town appears to be decidedly middle class even to the casual observer. Closer inspection reveals that it is a product of the coming together of old family Westerners and outsiders ("Easterners") who have become converts to a Western life-style. As a place where, in this sense, East meets West in a cultural melting pot seemingly designed to perpetuate the status quo, Sheridan is what our informants call "cliquey," "conservative," "cold," and yet "hospitable." The middle-class majority have deep ties to the land, either having spent much of their lives on ranches or farms or having relatives who are landowners. As such, the middle class are indeed conservative and inclined to resist change. Yet, the businessmen among them view future community growth (i.e., change) as good for business--at least to the point where chain store competition might come in and threaten their survival. While certainly good for business, recent change has brought with it some social elements (e.g., people who create law enforcement problems, undesirable neighbors, and the like) that give Sheridanites an unpleasant taste of what future social impacts might produce. The very rich--and Sheridan reportedly has some

exceptionally wealthy people--simply do not want the town to change. In the ordinary case they were attracted there because of the beauty of the surrounding area and its isolation from urban-industrial forces, and are not interested in the money which coal development might bring to the community. The very poor and the working classes tend to welcome change, feeling that they need new opportunities too much to extensively worry about social impact.

Sheridan's retired people, about a fourth of its total population, tend to be middle class in attitude and behavior and to share the mixed feelings of other middle-class residents about future growth. Thus far the elderly have not been particularly affected by community change, mainly because property taxes are still low (about a third of what Missoulians pay, for example) and their contacts with new people have been minimal.* Having more retired people per capita than any other city in Wyoming, it might be expected that Sheridan's voters would not be disposed to support increases in taxes to fund development of community services. Well, the fact is that the elderly have not been inclined to vote, although they are potentially the most powerful voting bloc in town. It will be interesting to watch their voting behavior as service-improving taxes are proposed. Meanwhile, the population of retired people has stopped growing in Sheridan because rapidly rising housing costs and the housing shortage have been discouraging people who had planned to retire there from doing so.

For all people in Sheridan, the meaning of rapidly increasing housing costs has been determined to some extent by how the increase has been

*See table G-35 concerning how Sheridanites compare their property taxes with those of other communities. One thing this comparison suggests is that Sheridanites of all description do not yet realize that their property taxes are actually lower than those in comparable communities in the region and, in a rapid population increase situation, have high growth potential.

Table G-35

Years of Residence in Sheridan County, by Opinion of Property Taxes in Comparable Communities
(percent)

| Do you think that property taxes in Sheridan are _____ taxes in comparable communities? | Years of Residence in Sheridan County | | | | | Total |
|-----------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------|-------------------------------|---------------|---------------------------|-------|
| | under 1 year | more than 1, less than 3 years | 3 but less than 5 years | 5-10 years | much or all of life | |
| Higher than | 0.8 | 1.7 | 1.7 | 0.0 | 4.2 | 8.3 |
| The same as | 0.0 | 1.7 | 2.5 | 2.5 | 18.3 | 25.0 |
| Lower than | 1.7 | 0.0 | 0.8 | 3.3 | 10.8 | 16.7 |
| Don't know | 3.3 | 1.7 | 5.0 | 5.8 | 34.2 | 50.0 |
| Total | 5.8 | 5.0 | 10.0 | 11.7 | 67.5 | 100.0 |

affecting them. As one respondent said, "It depends on whether you look at the housing market from the standpoint of a buyer or a seller, a renter or a landlord." Even so, many respondents who stand to gain personally from the increase feel that it is not good for the community and wish it would cease.

While the local economic situation is generally thought good, some aspects of it are problematic. Area ranchers and Sheridan businessmen find themselves unable to compete with the better than seven dollars per hour wages paid by Decker. Given the rising occupational expectations and hopes which go with industrial expansion, it is understandable that, although jobs are usually available for adults, the better paying jobs seem to elude many job seekers. Jobs for youth were reported to be much less plentiful than those for adults.

It is widely believed in Sheridan that Decker tends to bring in outsiders for its better paying jobs, leaving the less attractive ones for the locals. However, many Sheridanites believe that most of the hiring at Decker has thus far been done locally.

About 40 percent of the newcomers (i.e., people who have been in the city of Sheridan for less than one year) in Sheridan work for Decker, a factor in why the older residents usually are aware of Decker workers and their effects on the community. The nature of this awareness is open to question because 60 percent of the respondents indicated that they know little or nothing about plans to expand the Decker mine. It is well to note that, ordinarily, the community's awareness of Decker employees is positive. The general belief is that Decker has been economically beneficial to Sheridan and has caused little social disruption--

except for attracting a lot of job seekers for whom there are no jobs. The only criticism we heard concerning Decker's effects on the economic picture is the belief, expressed by a wide range of informants, that people with high wages tend to drive up prices and therefore make it harder for the retired and other low- and fixed-income people to get along. With reference to "the coal industry" and not to Decker alone, several informants expressed apprehension that some control over local political decision-making processes is already being exercised by industry through its ability to influence the votes of workers.

Some informants said that the rich control Sheridan although this is not obvious unless you know what is going on. "The rich" are usually the professionals and the bankers. These informants believed that this group wants development and is aggressively pushing for it. Early this year the Chamber of Commerce made a lobbying effort in Cheyenne to try to convince the legislators not to be so hard on industry as to drive them out. Observing this, these informants declared that the Chamber in its actions was not representing all the businessmen but only the rich decision makers, including local coal company officials.

There was much resentment among the several Decker and railroad workers we interviewed concerning having to pay Montana state income tax "for nothing." To them, the situation is a case of taxation without representation. On top of this they are not even getting public services for their money. Not surprisingly, therefore, about three quarters of the respondents thought that Montana should help pay part of Sheridan's public service bill.

We found general belief that the city's streets are gradually being improved, but that much paving of dirt roads must still be done. This is one area where the city government was thought to be getting on top of things. Otherwise there was widespread dissatisfaction: only 42 percent of the people said that they are satisfied with city government.

The people

The employed. More than 23 percent of the respondents in the survey were retired, and 4 percent were not employed for other reasons; 31 percent were employed as professionals, managers, or supervisors; 41 percent were blue-collar (including craftsmen and technicians) and clerical workers; and one percent (one respondent) was a rancher.

People in Sheridan were about evenly divided in their response to "from your standpoint, job opportunities are good" at the present time; 37 percent agreed, 47 percent disagreed, 13 percent were retired, and 3 percent responded "don't know." Many said that adults could get jobs if they want to but that there are few opportunities for young people. In the past Sheridan has had a large number of low-income people, many of whom work at low paying clerical and menial jobs. Businesses have had cheap labor and a captive market, but in the last year or so that kind of help was becoming harder to find as unemployment rates began to drop. More recently people coming in looking for coal development jobs that do not yet exist have increased the unemployment rate and added to the minimum wage labor pool.

Many people believe that Decker hires most of their help from outside the Decker area. Comments were made by several questionnaire respondents that "better jobs go to outsiders," "Decker, Texaco, and BN are notorious for bringing in people for the job; there are not that many locals hired."

The local employment office seems to get little call from the Decker mine, although an employment officer said that Sheridan could provide most of the required work force if there were housing. Reports of full page ads in Chicago papers offering employment with the company add to the belief that the Decker mine hires a lot of "outsiders." Of the sample of Decker employees in the Sheridan survey, 30 percent had lived in the county for less than a year and 40 percent for much or all of their lives. Had outlying trailer courts been sampled, the number of Decker-employed newcomers may have been higher.

To the statement, "Everything considered, I believe that approval should be granted to expand the Decker Mine," 55 percent of the blue-collar and clerical workers responded "yes," and more than 32 percent said "I need to know more about the expansion plans and likely consequences." This compares with 52 percent of the total sample who responded "yes" and 35 percent who said "I need to know more . . . " Forty-six percent of the professionals voted "yes," and 32 percent said "I need to know more . . . " Somewhat surprisingly, 57 percent of those who are retired voted "yes" and 32 percent said "I need to know more . . . "

The elderly. Why do retired persons in Sheridan approve of increasing coal development even more than those who might expect to find better jobs as a result of industry's expansion? A most popular answer is the old cliché, "you can't stop progress." Traditionally old-time residents identify with business. Even those who are retired ranchers tend to look upon ranching more as a business than as a way of life.

The older respondents also spoke of the need to "broaden the tax base," feeling that all of Sheridan's problems could be solved if there were more money for services without increasing their own taxes.

There are some interesting discrepancies in their responses. For example, those listing no employer (85 percent of whom are retired) were equally divided between agreement and disagreement with the statement that Sheridan can handle the increased population projected for expansion of the mine. The same group was equally divided in choosing between "economically beneficial" and "increased rents and living costs" as the principal effect of the Decker Coal Company on Sheridan. Yet 57 percent of the smaller group representing only the retired voted "yes" to mine expansion.

Ranchers in Montana. Most ranchers believed that there were very few in this area that could not make it without lease money, even with the depressed cattle prices. They said they have made it before through several years of low prices. They were also used to the ups and downs of the market, some saying you have to expect five bad years for every three good years, and a good manager recognizes this and does not overextend himself in the good years because he can always expect bad ones to follow. Some pointed out, however, that the difference between prices the past two years has never been so great and that generally when cattle prices are down so is the price of grain and some of the other expenses. That has not been true recently.

Oil leasing has been going on in some areas for as long as twenty years, and most ranchers throughout this area have done at least some oil leasing. There has been exploration, with the peak of the activity in the Otter-Sayle-Decker area about four years ago. Ranchers have considered the oil lease money as "gravy" with little or no consequences. Some informants believe that those who leased their land early for coal

also believed that this money would be such gravy and that the companies would let the options run out. One Forest Service informant said the biggest observable effect of leasing so far is all the new pickups and things the lease money is buying.

The ones who generally expressed doubt that most ranchers can make it without some outside source of income were in this category themselves. For them, coal leasing is one means of remaining in the ranching business. Even some of those opposed to coal development said there are few making it solely on ranching. Of course most ranchers do operate from year to year on short-term operating loans. Informants said that one thing ranchers most despise is owing anyone money, and perhaps the money guaranteed each year from coal leases is a means of making the rancher feel more independent.

Some owners of old-time ranches may be heavily mortgaged because they bought out the other heirs or because they have expanded, sometimes trying to put a ranch back together that had been divided among many heirs.

Several people have mentioned good management as the key to successful ranching no matter what the size or situation of the operation is. They have pointed out ranchers that should have everything going for them but are barely making it simply because they are poor managers. One informant said he has to spend one or two full days a week working on his books just to know where he is at, to determine whether he is making a profit or is going to have to borrow. He said most ranchers do not do that. They just go along from month to month trying to keep their costs and expenses in their heads, but when it comes to the end of the year they are not sure whether they have made money or lost. Other informants have said that

those who say they have to lease in order to keep their operation together are using that as a crutch for their poor management. They said the ranches that are in existence now are all of good enough size so that if they were run properly they would all make money.

Community relations are not as strong in the Decker and Kirby areas as in some other southeastern Montana ranching communities. More of the families are new (have come in the last 25 years), which means that some of the land changes hands quite often. In the Decker area, many ranch headquarters were wiped out in 1936 with construction of the Tongue River Reservoir. This caused many of the old established families to leave. Another reason given for the lack of community feeling was the size of ranches and therefore the distance between people. This has come about with the consolidation of ranches. With more and more dependence on Sheridan and improved access to it the people have been depending less and less on each other.*

Miners. Most of the respondents to the survey who were miners worked at Decker. Thirty percent of them had lived in Sheridan less than one year; 20 percent had been a resident for five to ten years and 40 percent much or all of their lives. Most of them owned their own homes although more lived in mobile home courts (10 percent) than the total survey population (four).** Forty percent of the miners reported that they were quite familiar with Decker's expansion plans compared to 11 percent in the total survey. More of them (20 percent) felt that local business gains and present taxes were sufficient to pay service costs related to Decker workers; only 11

* The rural area around Decker is depicted in the maps in Appendix SI-4.

** A large mobile home park a few miles outside the city was not surveyed.

percent of all those surveyed agreed with that choice. However, the rest of the miners surveyed were equally divided in how such costs should be paid; 40 percent chose "states of Montana and Wyoming should help . . . " and 40 percent chose "coal industry and the two states should help . . . "

Other Sheridan residents. Most of the survey respondents who worked at clerical jobs had lived in Sheridan much or all of their lives; 40 percent of them worked for government, a number of these at the VA hospital. Professionals, managers, and supervisors had more often moved to Sheridan in the past ten years, and more than one-third of them were self-employed.

Housing

Rosebud County, Montana. There is almost no housing available in Rosebud County south of the Northern Cheyenne Reservation. This southern section is the only part of Rosebud County that might be affected by the Decker mine. A few landowners have allowed one mobile home on their property, but there are no mobile home parks or housing developments in this area and no small towns that provide housing for the miners.

Big Horn County, Montana. The southern section of Big Horn County is much like the southern part of Rosebud County. There are essentially no housing, shopping, or community services. There have been no announced plans to build either mobile home parks or housing developments in Big Horn County. The county will not be able to provide significant housing for newcomers.

Sheridan County, Wyoming. Most of the employees at the Decker mine live in or near Sheridan. Few residents of Sheridan seem to expect great changes very soon. The impact of accelerated coal-related development is

a "maybe" for which they think there will be time to plan and otherwise prepare. "It is hard for us to grasp the likelihood of great change here,"* one said; but one great change that almost everyone was acutely aware of was in housing. The city of Sheridan has experienced a sharp increase in demand for housing over the past three years. Increasing costs and declining adequacy and availability of housing to rent or buy were apparent to most of the residents that were surveyed and interviewed. More than 80 percent of those in the study area disagreed with the statement that good housing is available in Sheridan (see table G-36). More than 70 percent said that rents are higher than two years ago, most of these reporting "much higher." From a list of seven items describing the most significant factors in community change in the past three years, 55 percent chose "housing costs." A social service official reported that not only is it difficult to find adequate housing but even inadequate units are unavailable. His low-income clients have been virtually priced out of the market for even marginal housing for which workers with higher incomes are willing to pay extraordinarily high rents. One of his co-workers who has lived in the area most of her life has, after months of effort, been unable to find a suitable "middle-class" rental.

Most residents estimated that an average two-bedroom, unfurnished apartment now rents for \$125 per month, not including utilities. The median of actual rents paid by 32 respondents was also \$125 per month, indicating that rent costs have increased about 55 percent during the past five years (the 1970 census reports the median rent was \$80 per month).

*Quotations from interviews may be paraphrased throughout this report.

Table G-36

Years of Residence in Sheridan County, by Agreement on Available Good Housing and Average Rent
(percent)

| Indicate whether you agree, disagree, or are neutral about available good housing in Sheridan. | Years of Residence in Sheridan County | | | | | Total |
|------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------|-------------------------------|---------------|---------------------------|-------|
| | under 1 year | more than 1, less than 3 years | 3 but less than 5 years | 5-10 years | much or all of life | |
| Agree | 0.8 | 0.8 | 0.8 | 0.8 | 4.2 | 7.5 |
| Disagree | 3.3 | 4.2 | 8.3 | 9.2 | 58.3 | 83.3 |
| Neutral | 1.7 | 0.0 | 0.8 | 0.8 | 4.2 | 7.5 |
| Declined to respond/don't know | 0.0 | 0.0 | 0.0 | 0.8 | 0.8 | 1.6 |
| Total | 5.8 | 5.0 | 10.0 | 11.7 | 67.5 | 100.0 |
| In Sheridan the average rent for an unfurnished, one-bedroom apartment without utilities is: | | | | | | |
| About \$100 per month | 0.0 | 0.0 | 2.5 | 4.2 | 12.5 | 19.2 |
| About \$125 per month | 3.3 | 2.5 | 3.3 | 2.5 | 18.3 | 30.0 |
| About \$150 per month | 0.8 | 2.5 | 2.5 | 3.3 | 15.0 | 24.2 |
| About \$175 per month or over | 0.0 | 0.0 | 0.8 | 0.0 | 9.2 | 10.0 |
| Don't know | 1.7 | 0.0 | 0.8 | 1.7 | 12.5 | 16.7 |
| Total | 5.8 | 5.0 | 10.0 | 11.7 | 67.5 | 100.0 |

Homeowners reported being offered as much as double what they paid for their property a few years ago.

What caused this drastic change in Sheridan's housing situation? Some of the increased cost is a result of nationwide inflation, but it is obvious that there has also been increasing demand for housing in Sheridan and no comparable building. Except for a few apartments, most housing construction has been single residences costing around \$50,000. The population increase was attributed to a combination of events: (1) a national trend to "escape" to small towns, (2) job seekers responding to publicity about coal-related development around Sheridan, (3) workers from coal-related developments such as those at Gillette settling their families in Sheridan where living conditions are more desirable, and (4) present activity at the Decker mine. Almost 70 percent of the residents of Sheridan believed that the arrival of Decker coal miners and related workers increased the cost of housing more than it would have increased as part of a national trend. Responding to "What has been the principal effect of the Decker Coal Company on Sheridan?," the greatest number (37 percent) chose "increased rents and living costs." A close second choice (34 percent) was "economically beneficial."

Most residents of Sheridan own their single family homes. Among these are many older people who expressed a wish to sell their property because it is hard for them to maintain. They would sell now, while they can get a good price, if only there were available apartments or mobile home parks especially designed for older residents. One such retirement facility has been in the planning stage for four years and is still at least a year from completion. All of the proposed units are already rented to the project's investors.

The Sheridan County planner is conducting a housing survey to gather information on occupied housing units and to determine the number of units which are unoccupied and available. The survey is over half completed and only eight units available for rent have been found. When the survey is finished, probably in October, more complete information will be available.

Using the preliminary data from the county planner and interviews with realtors, it is reasonable to state that there are fewer than 30 housing units available in Sheridan, excluding mobile homes. Not all of these units would be acceptable to miners or construction workers, particularly those with families.

Although newcomers to Sheridan do have the option of purchasing a mobile home, the existing mobile home parks in and around Sheridan have almost no vacancies. There is presently a moratorium on installation of new mobile homes within the city of Sheridan. Two new mobile home parks are under construction with a combined capacity of 125 units. The county and city restrictions on mobile home courts are stringent regarding water, utility hookups, and pavements. Slow development of mobile home parks can be expected to continue.

The cost of housing was reported by almost all questionnaire respondents and other interviewees to have risen sharply in the last three years. This reported increase was difficult to document. The county planner's housing survey should provide better information on housing costs.

Water and sewage

Rosebud County, Montana. Forsyth's municipal water system is now at the limit of its capacity. Because of its age, the plant must be fully

overhauled, modernized, and increased in capacity. The present 330,000 gallon reservoir is inadequate for a peak day's use and fire flow requirements. The two-cell lagoon sewage treatment system needs repair and enlargement to meet EPA standards. Western Energy Company is presently working to enlarge the water and sewage system in Colstrip.

Big Horn County, Montana. Hardin's water system is at its capacity and needs expansion. Plans are under way to supplement the existing system. The two-cell lagoon sewage system is also operating at capacity. The solid waste disposal is adequately handled with a landfill dump. The smaller towns in the county all have older water and sewage systems.

Sheridan County, Wyoming. The city of Sheridan has adequate water rights, five million gallons per day. This water volume is supplemented by storage capacity of 590 million gallons. The average demand is 4.2 million gallons per day. The peak demand was six million gallons in one day. The distribution system is divided between the north reservoir and south reservoir. This division aggravates distribution problems which result in minimally adequate service. Some reduction of water pressure has been noted in the north zone. A study is presently being conducted to determine changes needed in the distribution system. This work will be completed in January 1976.

Sheridan presently has sewage treatment capacity of 2.1 million gallons per day. Applying the standards used by the Wyoming State Engineer's office of 168 gallons per day per person, the present system is adequate for approximately 12,500 people. Given the present estimated population of 13,000 in Sheridan, the treatment capacity is inadequate. The limiting factor in the system is the sewage collection system, which is presently

overloaded in some sectors. The director of utilities is currently studying the demand on the collection system. When this report is completed in October 1975, data on collection system overloading will become available. In 1976 the city of Sheridan plans to request funds from the EPA for expansion of the water and waste treatment and collection systems. The city administrators hope that the EPA will fully fund the additions.

Transportation

Rosebud County, Montana. Amtrak train service (three trains weekly east and west) and daily Greyhound east-west bus service provide Forsyth with adequate surface transportation. A commuter bus provides daily service between Forsyth and Colstrip. Major air service is provided at the Billings airport. Expansion is being planned at the Forsyth airport; when the work is completed, the runway will be capable of handling small jet aircraft.

State route 315 from Colstrip to I-94 needs to be rebuilt. This route handles all road traffic into and out of Colstrip.

Big Horn County, Montana. Hardin is served by a daily Trailways bus running between Sheridan and Billings. Billings serves as a transportation center for Big Horn County. In general, the county roads need improvement. However, the state route from Decker to highway I-90 in Wyoming is in fairly good condition. The State Highway Department is presently conducting a survey of highway needs in the Decker area. This survey will provide information on the adequacy of highways in the area.

Sheridan County, Wyoming. One airline provides daily north and south flights through Sheridan from Denver and Billings. Two private companies

provide charter flights and air ambulance service. Complete daily bus service is available. Many county roads and city streets need improvement. Maintenance in the past has been adequate. Increases in traffic necessitate increased attention to road conditions. If the Decker mine expansion is approved, commuter bus service between Sheridan and Decker would alleviate traffic congestion.

Within Sheridan there is one cab company in operation. It is generally felt that a more available and less expensive cab company would be a very welcome addition to the community.

Schools

Rosebud County, Montana. The eight elementary and three high schools in Rosebud County are in reasonably good condition. The schools in Colstrip have experienced serious crowding. Nine modular classrooms are in use to alleviate some of the crowding, and a bond issue for expansion will be proposed to the voters in October. The small schools in the county lack diversity in their curriculum and in their audio-visual material and equipment. The Forsyth high school is expanding its vo-tech program. With the exception of Colstrip, the county has adequate schools.

Big Horn County, Montana. Big Horn County has a complicated assortment of school districts serving communities on the Crow Reservation and the rest of the county. Consolidation of the districts could prove beneficial for the quality of the schools. Although the unification of schools would cause transportation problems, it would allow more diversity in school programs and improvement in instructional materials available. New facilities are particularly needed at Lodge Grass to accommodate the growing

schoolage population. Decker has a small grade school whose capacity is about 20.

Sheridan County, Wyoming. Sheridan County is divided into three school districts. School District #2 includes the city of Sheridan and a large area around Sheridan. Almost all of the growth in Sheridan County has taken place in School District #2.

The ten public schools in School District #2 include seven schools housing grades K-6, one school housing grades K-8, one junior high school housing grades 7 and 8, and one senior high school housing grades 9-12. During the school year 1974-1975 these schools served 3,216 students. Four of the schools (Highland Park, Linden, Woodland Park, and Central Junior High School) operated during the 1974-1975 school year at or above capacity. Table G-37 gives the analysis of pupil/teacher loading.

The superintendent of School District #2 estimated that the district is capable of handling an additional 300 students. This additional capacity would be approximately half at the secondary level and half at the elementary level.

The additional elementary children would have to be bused to equalize school loads. Busing to equalize school loads is presently practiced and is, as noted below, an unpopular practice.

The quality of the school buildings varies considerably. Several schools require extensive repairs and remodeling. Table G-38 gives an indication of the age and condition of the school buildings.

School District #2 is not in the position of expanding the school facilities. The district has only approximately \$260,000 in bonding capacity remaining. The district will not have an increased bonding capacity

Table G-37

Factor Analysis of Land and Pupil/Teacher Loading, School District #2, Sheridan, Wyoming

| <u>Name of School</u> | <u>Grades</u> | <u>Teaching Stations</u> | <u>Number of Classroom Teachers</u> | <u>1972-73 Enrollment</u> | <u>Max. Pupil/Classroom Acceptable</u> | <u>Pupil/Teacher Ratio</u> | <u>Growth Factor (Pupils)</u> | <u>Existing Acreage</u> | <u>Desired Acreage</u> |
|-----------------------------|---------------|--------------------------|-------------------------------------|---------------------------|----------------------------------------|----------------------------|-------------------------------|-------------------------|------------------------|
| Coffeen School | K-6 | 19 | 19 | 411 | 1:27 | 1:21.6 | +5.4 | 9 | 9 |
| Highland Park | K-6 | 13 | 13 | 373 | 1:27 | 1:28.7 | -1.7 | 4.85 | 9 |
| Linden School | K-6 | 13 | 13 | 352 | 1:27 | 1:27 | capacity | 1.32 | 9 |
| Taylor School | K-6 | 7 | 7 | 165 | 1:27 | 1:23.6 | +3.4 | 2.1 | 7 |
| Acme School ¹ | 1-6 | 4 | 3 | 24 | 1:27 | 1:8.0 | N.A. | 6.0 est. | 5 |
| Beckton School ¹ | 1-6 | 2 | 1 | 12 | 1:27 | 1:12.0 | N.A. | .9 est. | 5 |
| Story School ¹ | K-6 | 3 | 3 | 49 | 1:27 | 1:16.3 | N.A. | .9 est. | 5 |
| Woodland Park | K-6 7-8 | 7 4 | 7 4 | 198 65 | 1:27 1:25 | 1:28.3 1:16.2 | -1.3 8.8 | 5.99 | 10 |
| Central School | 7-8 | 18 | 18 | 456 | 1:25 | 1:25.3 | -.3 | 4.39 | 20 |
| High School | 9-12 | 44 | 58 | 1,137 | 1:25 | 1:19.6 | +5.4 | 6.6 | 26 |
| Special Educ. | T-S | 7 | 6 | 67 | 1:10 | 1:11.1 | +3 | | 2 |

¹ Generalized acceptable standards of maximum pupils per classroom cannot be applied to the Acme, Beckton, or Story schools due to the multiple grading within each classroom area, thus negating growth factors.

Source: "Program for Growth: School District Number Two, Sheridan, Wyoming," prepared by Lewis-Eaton Partnership (architects-engineers-planners), Jackson, Mississippi, 1973.

Table G-38

Summary of School District #2 Facilities, Sheridan, Wyoming, 1972-1973

| Name and Location of School | Grades | Teaching Stations | 1972-73 School Enroll- ment | Major Special Facilities | Original Construction Date | Condition of Structure |
|--------------------------------------------|--------|----------------------|--------------------------------------|-------------------------------------------------------------------|----------------------------------|---------------------------------------------------------|
| | | | | | | |
| Coffeen School 1105 S. Sheridan Ave. | K-6 | 19 | 411 | library/resource center, gym-cafeteria combination | 1965 | good ¹ |
| Highland Park 1301 Avon | K-6 | 13 | 373 | library, gym-cafeteria combination | 1954 1966 (lib.) | good |
| Linden School Whitney St. @ Linden | K-6 | 13 | 352 | library, gym-cafeteria combination | 1916 1954 (add.) | deteriorated ² / dilapidated ³ |
| Taylor School 1020 N. Main St. | K-6 | 7 | 165 | gym/cafeteria combination, district superintendent's office | 1910 1941 (add.) 1954 (K) | deteriorated |

¹Good: those structures having no major defects or only slight defects normally corrected during the course of regular maintenance.

²Deteriorated: those structures requiring more repair than would be provided during the course of regular maintenance. They have one or more defects of an intermediate nature that must be corrected if these structures are to continue to provide adequate, economical, and safe shelter for schoolchildren.

³Dilapidated: those structures not providing adequate shelter due to one or more critical defects or a combination of intermediate defects in sufficient number to require extensive repair or rebuilding.

Table G-38 (continued)

| Name and Location of School | Grades | Teaching Stations | 1972-73 School Enroll- ment | Major Special Facilities | Original Construction Date | Condition of Structure |
|---------------------------------------------------------|--------|----------------------|--------------------------------------|---------------------------------------------|------------------------------------|---------------------------|
| | | | | | | |
| Acme School Acme, Wyoming | 1-6 | 4 | 24 | none | 1900 | dilapidated |
| Beckton School West of Sheridan | 1-6 | 2 | 12 | none | 1949 | good |
| Story School Story, Wyoming | K-6 | 4 | 49 | none | 1956 | good |
| Woodland Park Buffalo Star Route | K-8 | 14 | 263 | gym-cafeteria combination | 1952 1959 (add.) 1964 (add.) | good/ deteriorating |
| Central Junior High Custer Ave. @ East Loucks St. | 7-8 | 18 | 456 | auditorium, library, gym, cafeteria | 1919 1956 (add.) 1966 (add.) | good/ deteriorating |
| High School Lewis St. @ Adair | 9-12 | 37 | 1,137 | gym, resource center, library, cafeteria | 1926 | deteriorating |
| Agricultural Bldg. | | 2 | | | 1972 | good |
| Industrial Arts Bldg. | | 5 | | | | good |
| Hill School Gym | | - | | | 1950 | dilapidated |
| Hill School (Special Ed.) | | T-S* | 67 | none | 1908 | dilapidated |

*Trainable; intermediate; junior high; and senior high students.

Source: "Program for Growth: School District Number Two, Sheridan, Wyoming," prepared by Lewis-Eaton Partnership (architects-engineers-planners), Jackson, Mississippi, 1973.

in the foreseeable future. Because the district levies the maximum allowable millage, 25 mills as of July 1, 1975, it receives supplemental funds from the state. These funds, estimated by the superintendent at \$400,000, are restricted to operating expenses and may not be used for capital expenses.

Given the condition of the district's existing facilities and the present pupil/teacher loadings, the school system is only marginally adequate. The busing of children from one neighborhood to another is the source of serious parental irritation ("This is getting to be just like the big cities we left to come here") and reflects pressure on existing facilities. The extra capacity, noted by the superintendent, refers to aggregate classroom space, not the ability to adequately maintain or expand the total physical plant of the school system.

Sheridan's housing situation makes it very difficult for new school personnel to find/afford suitable housing. A school official said that salaries in the mining industry have affected this problem by attracting away several certified and noncertified school employees.

The survey indicated general satisfaction with the grade schools and high school. When asked about the schools, 72 percent said they were satisfied with the grade schools, and 62 percent said they were satisfied with the high school.

School District #1, which includes the communities of Big Horn, Dayton, and Ranchester, has a total enrollment of 627. Table G-39 gives the distribution of students.

The superintendent estimated that the Big Horn elementary school could handle a maximum of 40 to 50 additional students and that the Tongue River elementary school could handle only 15 to 20 additional students.

Table G-39

Enrollment by School in School District #1, Sheridan County

| | <u>Big Horn</u> | <u>Tongue River Area</u> |
|-------------|-----------------|--------------------------|
| High school | 100 | 140 (at Dayton) |
| Junior High | 45 | 63 |
| K-6 | 123 | 152 (at Ranchester) |

Both high schools are at their capacity. A bond issue for an elementary/junior high at Ranchester is in the planning stages.

School District #3, which serves Clearmont and Arvada, has a total enrollment of 109. There are 45 in the high school, 20 in the junior high, and 44 in the elementary school. The superintendent estimated that the present total enrollment could be doubled without additional facilities.

Recreation

Rosebud County, Montana. Forsyth has very few organized recreational programs. These consist of little league baseball, school sports programs, and activities at the Senior Citizens Center. The municipal swimming pool needs improvement but presently offers free swimming in the summer. Hunting and fishing are primary recreational activities.

Colstrip has a serious shortage of recreational facilities. Western Energy spokesmen state that they have plans to build a wide variety of facilities.

Big Horn County, Montana. Hardin has very limited recreational facilities and opportunities. Some plans have been made for a badly needed youth recreational center and swimming pool. Hunting is one of the principal recreational activities. Organized youth activities are limited to school functions. Both organized activities and opportunities for unorganized recreation need to be increased.

Sheridan County, Wyoming. Sheridan County has varied recreational opportunities for all age groups. The YMCA, which is well endowed by local foundations, offers a wide variety of recreational facilities and programs. Annual membership in the YMCA, which now costs \$96 for a family

membership and \$25 for a high school student, is prohibitive for many families. The city provides a swimming pool, tennis courts, golf course, gymnasium, ice skating rinks, playgrounds, and a small zoo. Many respondents commented that Sheridanites have easy access to good hunting and fishing. A few observed that, for those who like outdoor activity, Sheridan is an especially good place to retire. Within the city, however, most people felt that there are only limited recreational opportunities for all who are on tight budgets. The recreational facilities are above average for a town the size of Sheridan. According to our survey, 74 percent of respondents expressed satisfaction with the recreational facilities.

Public Safety

Law Enforcement

Rosebud County, Montana. Rosebud County is served by a 15-man, combined city-county law enforcement department. Ten men are assigned to Forsyth, two to Colstrip, two to Ashland, and one to Birney. Population estimates suggest that the county falls short of meeting national adequacy standards of one officer per 500 residents. Two highway patrolmen operate in Rosebud County.

Big Horn County, Montana. A seven-man police force serves Hardin. The force is equipped with only two cars and handles only minor problems. Felonies are investigated by the sheriff's department. The sheriff and other deputies are responsible for all of Big Horn County excluding Indians on the Crow Reservation but including whites on the reservation. Given the equipment shortages and the division of responsibility, the law

enforcement coverage is inadequate. The sheriff is also the county fire marshal. This responsibility could be better filled by some other person or organization. Indian police have responsibility for tribal members on the reservation.

Sheridan County, Wyoming. The city of Sheridan is served by a 21-member police department. This number is inadequate. The sheriff's department has six full-time officers. This number is also inadequate. Given a population in Sheridan of approximately 13,000 and in the county outside of Sheridan of 6,300, the city police should have 26 members and the sheriff's department should have 13 members.*

In the past when Sheridan was homogenous and stable, a police and sheriff's department smaller than state adequacy standards might have been acceptable. The quality of police protection was an important item to the survey respondents. A majority, 56 percent, indicated that they were satisfied with police protection. However, when the respondents were given a list of eight community services and asked to pick the service that most needs to be improved, the police services were the second most common one selected (see table G-40).

Sheridan's current law enforcement situation. Over the years, Sheridanites have come to expect the police department to provide a variety of helping services in addition to law enforcement. As a result the relationship between police officers and townspeople has been friendly, cordial, and informal. The community's rapid growth during the past few years has begun to change this relationship, owing to the influx of many

*Using the adequacy standard of one officer per 500 population is derived from the national and Wyoming averages as cited in "Capital Facilities Study: Powder River Basin," by Intermountain Planners and Wirth-Berger Associates, prepared for the Wyoming Department of Economic Planning and Development, April 1, 1974, page 52.

Table G-40

**Years of Residence in Sheridan County, by Services Most Needing Improvement--First and Second Choices
(percent)**

| In Sheridan, which of these services most needs to be improved? | Years of Residence in Sheridan County | | | | | Total |
|--------------------------------------------------------------------|---------------------------------------|--------------------------------------|-------------------------------|---------------|---------------------------|-------|
| | under 1 year | more than 1, less than 3 years | 3 but less than 5 years | 5-10 years | much or all of life | |
| <u>First choice</u> | | | | | | |
| schools | 0.0 | 0.0 | 2.5 | 1.7 | 10.0 | 14.2 |
| police | 0.0 | 0.8 | 0.8 | 0.0 | 15.8 | 17.5 |
| fire | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 |
| health care | 0.8 | 0.0 | 0.0 | 0.0 | 1.7 | 2.5 |
| water/sewage | 0.8 | 0.8 | 0.8 | 0.0 | 4.2 | 6.7 |
| streets/roads | 1.7 | 3.3 | 3.3 | 3.3 | 12.5 | 24.2 |
| city government | 0.0 | 0.0 | 1.7 | 3.3 | 10.8 | 15.8 |
| county government | 0.0 | 0.0 | 0.0 | 0.8 | 1.7 | 2.5 |
| declined to respond/don't know/none | 2.5 | 0.0 | 0.8 | 2.5 | 8.3 | 14.2 |
| Total | 5.8 | 5.0 | 10.0 | 11.7 | 67.5 | 100.0 |
| <u>Second choice</u> | | | | | | |
| schools | 0.0 | 0.8 | 0.8 | 0.0 | 5.8 | 7.5 |
| police | 0.0 | 0.0 | 0.8 | 1.7 | 14.2 | 16.7 |
| fire | 0.0 | 0.0 | 0.0 | 0.0 | 3.3 | 3.3 |
| health care | 0.0 | 2.5 | 0.0 | 0.0 | 6.7 | 9.2 |
| water/sewage | 1.7 | 0.8 | 0.8 | 0.8 | 5.8 | 10.0 |
| streets/roads | 0.0 | 0.0 | 1.7 | 0.8 | 5.0 | 7.5 |
| city government | 0.8 | 0.0 | 4.2 | 1.7 | 7.5 | 14.2 |
| county government | 0.0 | 0.0 | 0.0 | 1.7 | 3.3 | 5.0 |
| declined to respond/don't know/none | 3.3 | 0.8 | 1.7 | 5.0 | 15.8 | 26.7 |
| Total | 5.8 | 5.0 | 10.0 | 11.7 | 67.5 | 100.0 |

Table G-41

Years of Residence in Sheridan County, by Satisfaction with Police Protection
(percent)

| Are you satisfied at present with police protection? | Years of Residence in Sheridan County | | | | | Total |
|---------------------------------------------------------|---------------------------------------|--------------------------------------|-------------------------------|---------------|---------------------------|-------|
| | under 1 year | more than 1, less than 3 years | 3 but less than 5 years | 5-10 years | much or all of life | |
| Satisfied | 5.8 | 3.3 | 5.8 | 6.7 | 34.2 | 55.8 |
| Dissatisfied | 0.0 | 0.8 | 3.3 | 1.7 | 25.8 | 31.7 |
| Neutral | 0.0 | 0.0 | 0.8 | 3.3 | 6.7 | 10.8 |
| Don't know | 0.0 | 0.8 | 0.0 | 0.0 | 0.8 | 1.7 |
| Total | 5.8 | 5.0 | 10.0 | 11.7 | 67.5 | 100.0 |

job seekers who cannot be counted on to treat policemen as friends and neighbors. This urbanizing influence has forced the police to become less trustful and more formal than they have been and has led our respondents to feel that, although the police department recently hired four new men, it needs to add still more officers if it is to adequately meet present law enforcement demands. Accordingly, when only 56 percent of the respondents indicated that they were satisfied with police protection (see table G-41), the message we were getting was that dissatisfaction was more with lack of numbers than lack of quality. The job to be done is generally thought to require a larger police force.

Fire Protection

Rosebud County, Montana. A well-organized, 17-member city volunteer fire department serves Forsyth. The sheriff's department is responsible for providing a volunteer force to fight rural fires. The county fire unit has three spray trucks, one six-by-six Army surplus truck with a 2,000 gallon tank, and one 1935 fire truck. Colstrip is served by a company-owned truck and a 12-man company fire department.

The fire protection is presently adequate for Forsyth and Colstrip. The rural protection could be stronger if an organized volunteer force existed.

Big Horn County, Montana. A 15-member volunteer city force serves Hardin. The rural areas are served by volunteer firemen consisting of sheriff's deputies and employees of the county roads and bridge department. Hardin has one new fire truck and one backup truck. The county has two trucks, each having 1,000 gallon tank capacity. Lodge Grass and Decker

each have an Army surplus six-by-six truck with a tank and pump. In the past, Sheridan County trucks have assisted in the Decker area. The Wyoming Attorney General has ruled that Wyoming trucks may not cross state borders. Considering this situation, the fire protection for the Decker area should be increased.

Sheridan County, Wyoming. A 16-man, full-time fire department serves the city of Sheridan. The department is equipped with three trucks with pumps of 750 gallons per minute capacity or greater. The present equipment is adequate for Sheridan. Respondents generally felt that the fire department is of high quality but of barely sufficient size. Several pointedly suggested that another fire station would be desirable. A more pressing problem lies in the annexation of areas which have inadequate waterlines.

The county has a four-man force at the airport, providing 24-hour, on-duty service. The force has three trucks with pumping capacities of 500, 750, and 1,900 gallons per minute. In addition, each of the 12 fire zones has a four-by-four truck with 275 gallons of water for fighting prairie fires.

The Veterans Administration Hospital has its own fire department and equipment.

Social and welfare services

Rosebud County, Montana. Five staff members serve the combined Rosebud County and Treasure County Welfare Department located in Forsyth. Assistance payments have continued at the same level for several years and possibly will not increase as the population grows and job opportunities expand. Some increases in welfare loads in Colstrip might be expected during the intervals between peak construction periods or before workers are able to relocate.

The department provides home visits by a professional homemaker to the elderly, disabled, and blind. The only youth services are available from the mental health outreach workers and the local drug and alcoholism programs.

The Rosebud residents expressed satisfaction with the adequacy of the welfare services offered.

Big Horn County, Montana. The Big Horn County Welfare Department is operated by a seven-member staff, including two social workers and one full-time and one part-time homemaker. The department handles all categories of welfare in the county and all categories except general assistance and child welfare on the Crow Reservation. These two programs are handled by the BIA welfare office. The county welfare staff report spending much of their time on Indian-related work.

There are no special outreach programs for senior citizens or youth. The department feels that a need exists for both programs. The funding is not presently available. Other than these areas of need, the welfare services are adequate.

Sheridan County, Wyoming. A staff of nine operates the welfare department in Sheridan. Their caseloads include 119 receiving Aid to Families of Dependent Children, 33 children in foster homes, and from six to eight each month receiving General Assistance payments. Two hundred fifty receive Social Security incremental payments, a larger number than normal for a community the size of Sheridan. This load may be attributed to the larger-than-average population of residents who are 65 or older. The department considered other caseloads normal for a community the size of Sheridan.

The welfare department has very limited outreach capabilities. The

YMCA, which is very well endowed, has a wide variety of programs for both the elderly and youth. There is a Meals-on-Wheels program operated by volunteers and a senior citizens' bus.

A Youth Services Project, which is funded by a Law Enforcement Assistance Administration grant and is related to the juvenile court, provides an information service, family counseling, and a job opportunities program for youth. Counseling services are available from the Mental Health Center. Also, there is an extensive alcoholism program for veterans and Indians at the local VA hospital.

Health Services

Health Care Personnel

Rosebud County, Montana. Presently one physician practices in Forsyth. A nurse practitioner operates in a clinic office in Colstrip where a doctor is available one day a week. Ashland has a similar clinic which is visited weekly by a doctor. One Public Health nurse serves all of Rosebud County. The county's greatest health care need is for skilled nurses and physicians, especially physicians. Many patients currently prefer to travel to Miles City, Billings, or Sheridan, Wyoming for treatment of minor ailments. Using the standard of one physician per 1,222 persons, Rosebud County should have at least five more physicians. Colstrip, which has a population of approximately 2,000, does not have a resident physician. At least one more Public Health nurse is needed for the county.

Big Horn County, Montana. One physician and one physician's assistant serve the hospital in Hardin, Montana. The Indian Health Service operates an out-patient clinic at Lane Deer on the Northern Cheyenne Reservation, and the Northern Cheyenne tribe expects to construct a million dollar Indian

Health Service clinic building at Lame Deer this year. An Indian Health Service hospital at Crow Agency on the Crow Reservation serves both reservations. There are two Indian Health Service physicians, three nurses, and one physician's assistant at Lame Deer and Crow Agency. Their practice is limited to tribal members only. The physicians have historically left after completing their two-year commitment to the Indian Health Service. Presently non-Indian residents go to Billings or Sheridan.

Using the above-mentioned standard for physicians, Big Horn County needs five to six more physicians to provide adequate medical service in the county.

Sheridan County, Wyoming. Sheridan has 21 physicians, including such specialists as a pathologist, a radiologist, and pediatricians. There are approximately 60 registered nurses at the hospital. The hospital has complete laboratory facilities. The number of physicians exceeds the adequacy standard for Sheridan County. As mentioned before, Sheridan serves as a regional medical center. The personnel are presently adequate for this role.

In the survey of the city of Sheridan (see "Questionnaire Responses," pp. G-188 ff.) 80 percent of the respondents indicated satisfaction with the medical services in Sheridan. Only 10 percent indicated dissatisfaction. The responses tend to indicate that the medical services in Sheridan have in the past been adequate.

Sheridan's present health situation. While over 80 percent of Sheridan's residents indicate that they are satisfied with the city's medical and dental services, some who are generally satisfied go to Billings (especially to the Billings Clinic) for the services of

specialists, and those who are not satisfied usually go to Billings for all of their health care. There is a little less satisfaction (a little over 70 percent) with Sheridan's hospital, which several respondents who claimed to be particularly well informed about the situation said is due to the hospital personnel being too resistant to making the changes which young doctors often attempt to make. Some of the turnover among new doctors is thought by these informants to be an expression of the doctors' frustration with the hospital personnel--and with the older doctors who typically fail to rally to their support. Some cynics believe that too many of the younger doctors who stay in town only a short time are attracted more by money than the opportunity for serving mankind. For example, one respondent, commenting on the recent high turnover of young doctors, said: "They are perfectly reasonable. If they can't make their fortune in two weeks, they are willing to stay three."

Respondents generally felt that health care for the elderly left much to be desired. Their reaction to the town's nursing home was mixed, and they pointed to the need for retirement facilities which would offer desired health services to residents who are still essentially able to care for themselves.

The rapidly rising cost of health care in Sheridan is generally thought to be unrelated to coal development.

Hospitals

Rosebud County, Montana. A new 26-bed hospital serves Forsyth and northern Rosebud County. The facilities include coronary and intensive care units. The hospital administration estimates an occupancy rate of

approximately 80 percent. The hospital appears adequate for the area. However, as noted before, the limiting factor on the availability of health care is the shortage of physicians and nurses. Many patients use Miles City and principally Billings for hospital services. The Northern Cheyenne use the Indian Health Service hospital at Crow Agency. People living south of the Northern Cheyenne Reservation in Rosebud County use the Sheridan hospital or one of the Billings hospitals.

Big Horn County, Montana. A new 16-bed hospital serves Hardin and the non-Indian population of Big Horn County. The hospital is well equipped for its size. Indians from the Crow Reservation must use the Indian Health Service hospital at Crow Agency if they are receiving federally financed medical care.

Again, the factor limiting health care is the number of physicians and nurses. The hospital, even with its approximately 50 percent occupancy rate, appears to be presently adequate. Many residents use hospitals in Billings and Sheridan.

The hospital at Crow Agency serves only tribal members. Some members elect to pay for their own medical expenses and use hospitals in Sheridan and Billings.

Sheridan County, Wyoming. The 89-bed Sheridan hospital is the best staffed and provides the most extensive facilities in the study area. The hospital has a coronary care unit as well as surgical, obstetrical, pathological, and radiological services.

Using the standard of four hospital beds per 1,000 people,* the

*The adequacy standard of four beds per 1,000 population is based on the national average of 1,183 patient days per 1,000 of population multiplied by roughly 82 percent average occupancy rate for each hospital. These figures lead to a projected need of four hospital beds per 1,000 of population in each county.

hospital facilities are more than adequate for the population of Sheridan County. In the survey of the city of Sheridan, 72 percent of the respondents indicated that they are satisfied with the hospital services.

The hospital serves the patients of Big Horn County and Rosebud County in Montana and Campbell County and Johnson County in Wyoming. When these counties are considered, judging the adequacy of the hospital is more complex. The 89 beds are adequate for a population of approximately 22,200, using the standard of four beds per 1,000 population. This figure exceeds the present population of Sheridan County.

Approximately 30 percent of the patients using the Sheridan hospital live outside of Sheridan County. The size of this group indicates that changes in population in surrounding counties, particularly Campbell County, will have a significant impact on the Sheridan hospital.

Ambulances

Rosebud County, Montana. Ambulance service for the northern part of the county is provided by one county-owned ambulance. This vehicle lacks respiratory equipment. There is no backup vehicle. Western Energy Company has an ambulance for Colstrip, there are five company employees with emergency medical training.

The Indian Health Service provides ambulance service for the Northern Cheyenne Reservation. Rosebud residents living south of the reservation depend on the two ambulances in Sheridan.

Big Horn County, Montana. Two ambulances, which are operated by three salaried staff, provide good ambulance service for Big Horn County. The ambulance crew is well trained in emergency medical procedures.

Decker Coal Company officials have indicated that the company would have an ambulance and crew on duty at the proposed mine sites.

Sheridan County, Wyoming. Two Sheridan funeral homes provide Sheridan County with two ambulances and a backup vehicle. These units also provide service to Decker and Birney in Montana because these towns are closer to the city of Sheridan than to the major service areas in their own counties. The ambulance operators have some training in first-aid procedures, but emergency medical services are not their primary daily concern.

While 73 percent of the people in Sheridan are satisfied with the ambulance service, it is not a profit-making venture according to the funeral home operators. Expansion of the service or addition of more sophisticated equipment will depend on the good will of the present operators or contributions by the city, county, or hospital.

Retirement/Nursing Homes

Rosebud County, Montana. A 39-bed nursing wing is attached to the hospital at Forsyth. For the present, this facility is meeting the needs of the elderly in Rosebud County.

A retirement home may be needed if housing costs continue to increase, forcing the elderly out of their homes and apartments.

Big Horn County, Montana. A 34-bed, county-supported nursing home is connected to the hospital at Hardin. The facility is designed for elderly patients needing constant care. One R.N. and one L.P.N. supervise each shift. A 22-bed nursing home provides services for elderly needing less intensive attention. A part-time R.N., as well as physical and occupational therapists, is available to work with the patients as needed.

Both facilities have very short waiting lists of three to five. In

the past, such waiting lists have not meant the denial of services to the elderly. The two facilities are considered adequate to meet present demands.

Sheridan County, Wyoming. A 96-bed nursing home and extended care facility serves Sheridan and the surrounding counties. The nursing home has professional therapists providing physical, occupational, and speech therapy programs. A retirement home for 120 persons is planned. This retirement home will be quite expensive, costing a minimum of \$200 per month for an efficiency apartment and \$75 or \$80 per month for required partaking of noon meals. The bonds which will finance this home have not yet been sold. A waiting list already exists for this home.

In 1970, 16 percent of the Sheridan County population was 65 or older. This sizable group places more demands on geriatric service in Sheridan County than is found in other parts of the study area. In the past, the elderly have been able to find reasonably priced housing in Sheridan; in fact, most of them live in their own homes.

In the survey, 81 percent of the respondents indicated satisfaction with services for senior citizens.

Mental Health Facilities

Rosebud County, Montana. The Eastern Montana Mental Health Center, which serves an 18-county area from its headquarters in Miles City, provides one full-time counselor to serve Rosebud County. The counselor works in a Forsyth office and does not have outreach programs. Mental health assistance in Rosebud County is limited to residents of Forsyth and those who are willing and able to travel to Forsyth.

Big Horn County, Montana. The South Central Montana Mental Health

District has two staff members in Hardin. Their outreach efforts are mainly devoted to school-related problems. Their caseloads are heavy, limiting the development of needed educational and preventative programs.

Sheridan County, Wyoming. The Northeast Wyoming Mental Health Organization serves a five-county area of northern Wyoming. The organization, which is located in Sheridan, has five full-time staff members including a psychiatrist and a child psychiatrist. The Mental Health Center offers comprehensive services which are above average for Wyoming communities. The staff feels that the programs are minimal compared with the local needs.

The organization is funded by the city and county. The county has refused to increase its appropriations for the organization. The staff members have opposed state involvement because of the state's restrictions and controls. Although the program appears above average, and the center seems to have emerged as the leader and coordinator of the area's mental health service programs, funding was reported to be tenuous and subject to future fluctuation.

Impact on social structure and social services

Introduction

It was very difficult for people to imagine the impact of developments that they had not experienced. Most of them felt sure that they would welcome "development" (payrolls and tax revenues) but not "growth" (crowding and inflated prices). The present Decker mine operation seemed to them to represent desirable "development" without undesirable "growth." Responses to our survey questionnaire shed light on the development-growth dilemma and related matters.

There was substantial agreement among our respondents that the impact of the 250 or so new families on community services would be detrimental. Particularly hard hit, they believed, would be police protection (76 percent thought the impact would be detrimental) and grade schools (72 percent). In fact, more than half of the people thought that the high school (65 percent), sewage service (62 percent), hospital services (61 percent), water supply system (59 percent), streets and roads (57 percent), fire protection (56 percent), and recreational facilities (55 percent) would be adversely affected by the population influx resulting from expansion of the Decker mine. Moreover, between 41 and 48 percent thought that shopping facilities (48 percent), medical services (48 percent), ambulance service (43 percent), city government (42 percent), and dental services (41 percent) would be adversely affected. Least affected would be mental health services (37 percent) and county government (34 percent). Forty-seven percent thought that service to senior citizens would be unaffected.

Our respondents felt slightly more sanguine about other likely impacts. For example, 54 percent thought that there will probably be more jobs (see

table G-42), 59 percent believed that local people will still control decisions (see table G-43), and 49 percent anticipated that newcomers will be easily accepted into the community (see table G-44). On the other hand, it was the feeling of 81 percent that the price of housing will go up sharply, 45 percent thought that Sheridan will not be a better place to live, 41 percent thought that the town will be unable to handle the 1,000 or so new people (see table G-45), and 57 percent thought that they will be less safe than they have been. It was the expectation of 74 percent of those we surveyed that the population influx will have no effect on their feeling of being a part of the community of Sheridan, 73 percent that the influx will have no effect on their overall feelings toward the town, 62 percent that the influx will not affect their enjoyment of life in general, and 52 percent that the influx will have no effect on their opportunities for better or more secure jobs.

As for the main changes in Sheridan during the past three years, 55 percent thought that housing costs had changed (i.e., risen) most, while 27 percent thought that other living costs had changed most. Decker's principal effect on Sheridan has been twofold according to our respondents. Whereas 34 percent said that the company's principal effect on the town has been economically beneficial, 37 percent said that its principal effect has been to increase rents and living costs. Overall, however, people in Sheridan have a positive feeling toward Decker, and 52 percent would definitely not oppose the proposed mine expansion. Others (35 percent) would like more information about these plans and the likely consequences before making up their minds on the expansion question.

Table G-42

Head of Household's Employer, by Reaction to the Statement that the Expected
Population Influx would Generate More Jobs in Sheridan
(percent)

| If 250 families (at least 1,000 people) move into Sheridan, would you agree, disagree, or be neutral toward the state- ment that there would be more jobs in Sheridan? | Head of Household's Employer | | | | | | Declined to respond | Total |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|---------------------------|-------|
| | Self- employed | Govern- ment | Mine- related/ Decker | Mine- related/ Big Horn | Mine- related/ other | Other nongov- ernmental | N.A. | |
| Agree | 10.8 | 8.3 | 5.8 | 1.7 | 0.8 | 11.7 | 13.3 | 54.2 |
| Disagree | 5.8 | 5.8 | 0.8 | 0.0 | 0.0 | 17.5 | 6.7 | 38.3 |
| Neutral | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 2.5 | 0.8 | 4.2 |
| Don't know | 0.8 | 0.0 | 0.8 | 0.0 | 0.0 | 0.8 | 0.8 | 3.3 |
| Total | 17.5 | 14.2 | 8.3 | 1.7 | 0.8 | 32.5 | 21.7 | 100.0 |

Table G-43

**Head of Household's Employer, by Reaction to Statement that the Expected
Population Influx Would Not Affect the Control of Local Decisions
(percent)**

| If 250 families (at least 1,000 people) move into Sheridan, would you agree, disagree, or be neutral toward the state- ment that local people would still control decisions? | Head of Household's Employer | | | | | | Declined to respond | Total |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|---------------------------|-------|
| | Self- employed | Govern- ment | Mine- related/ Decker | Mine- related/ Big Horn | Mine- related/ other | Other nongov- ernmental | N.A. | |
| Agree | 10.8 | 9.2 | 3.3 | 1.7 | 0.8 | 19.2 | 11.7 | 59.2 |
| Disagree | 4.2 | 2.5 | 4.2 | 0.0 | 0.0 | 6.7 | 5.0 | 22.5 |
| Neutral | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 0.8 | 3.3 |
| Don't know | 2.5 | 2.5 | 0.8 | 0.0 | 0.0 | 4.2 | 4.2 | 15.0 |
| Total | 17.5 | 14.2 | 8.3 | 1.7 | 0.8 | 32.5 | 21.7 | 100.0 |

Table G-44

Head of Household's Employer, by Reaction to Statement that Newcomers Would be Easily Accepted Into Community if 250 New Families Move Into Sheridan
(percent)

| If 250 families (at least 1,000 people) move into Sheridan, would you agree, disagree, or be neutral toward the statement that the newcomers would be easily accepted into the community? | Head of Household's Employer | | | | | | Declined to respond | Total |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------------|---------------------|-----------------------|--------------------|-----------------------|---------------------|-------|
| | Self-employed | Government | Mine-related/Decker | Mine-related/Big Horn | Mine-related/other | Other nongovernmental | | |
| Agree | 9.2 | 5.0 | 3.3 | 0.8 | 0.0 | 16.7 | 1.7 | 49.2 |
| Disagree | 4.2 | 4.2 | 3.3 | 0.8 | 0.0 | 8.3 | 1.7 | 25.0 |
| Neutral | 2.5 | 2.5 | 0.8 | 0.0 | 0.8 | 2.5 | 0.0 | 11.7 |
| Don't know | 1.7 | 2.5 | 0.8 | 0.0 | 0.0 | 5.0 | 0.0 | 14.2 |
| Total | 17.5 | 14.2 | 8.3 | 1.7 | 0.8 | 32.5 | 3.3 | 100.0 |

Table Q-45

Head of Household's Employer, by Reaction to Statement that Sheridan
Could Handle Expected Population Increase
(percent)

| If 250 families (at least 1,000 people) move into Sheridan, would you agree, disagree, or be neutral toward the statement that Sheridan could handle that many more people? | Head of Household's Employer | | | | | | Declined to respond | Total |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|---------------------------|-------|
| | Self- employed | Govern- ment | Mine- related/ Decker | Mine- related/ Big Horn | Mine- related/ other | Other nongov- ernmental | | |
| Agree | 2.5 | 5.8 | 5.8 | 0.0 | 0.8 | 11.7 | 1.7 | 36.7 |
| Disagree | 8.3 | 6.7 | 0.8 | 1.7 | 0.0 | 14.2 | 0.8 | 40.8 |
| Neutral | 2.5 | 1.7 | 0.8 | 0.0 | 0.0 | 0.8 | 0.8 | 8.3 |
| Don't know | 4.2 | 0.0 | 0.8 | 0.0 | 0.0 | 5.8 | 0.0 | 14.2 |
| Total | 17.5 | 14.2 | 8.3 | 1.7 | 0.8 | 32.5 | 3.3 | 100.0 |

7
1
14
5

In general, respondents felt that it was somewhat difficult for them to separate Decker's past social impact from that of other coal companies and extremely difficult to separate out future ones, given what they have heard about the likelihood that other companies' development plans will soon be implemented. Moreover, even though the analysis of population which appears elsewhere in this report suggests that the proposed expansion might cause Sheridan's population to increase by 1,500 to 2,000, we feel confident that the people we surveyed would have responded no differently to these figures than they did to the phrase, "at least 1,000 (more) people," which we used in the questionnaire. Our respondents had so much difficulty imagining what an increase of a thousand or so people would be like that it would not have made any difference in their responses if we had asked about the increase in terms of 1,500 to 2,000 new people.

Quality of Life and Social Values

During the course of our interviews with questionnaire respondents we heard a number of remarks about what the proposed Decker mine expansion will do to or for Sheridan, its way of life, and its social structure. The following are some representative quotes concerning these general impacts. More specific impacts on housing, community services, and the like will be discussed in subsequent sections.

It is hard for us to grasp the likelihood of great change here. Some of the business interests would welcome it, but most of us really don't welcome it, even though we feel we should go along with it.

What if we become another Gillette or Rock Springs? Does the country really need the energy that badly?

No matter what happens, Sheridan will cope. Sheridan has always risen to the occasion. We will cope if we have to.

Our enjoyment of life will be negatively affected by more people and more traffic and not knowing the people you meet on the street.

Will the locals still control things? I hope so.

More liberals and colored people will come in.

If we just had to contend with new people, fine, but we'll have to contend with industry. I have in mind that other companies will be moving here, too.

Sheridan can't get any better.

I can't see that the town would change that much. I've been in boom towns and generally there was no long lasting effect.

Table G-46 shows what effect residents of Sheridan thought the present strip mining operations have had on their community.

The people

The employed. One-fourth of the respondents to the survey said that their own job opportunities would be improved or more secure if the mine expanded, and 52 percent said expansion would have no effect on their own jobs. Conversely, 54 percent said that there would be more jobs available in Sheridan and 38 percent disagreed. This compares with 37 percent who agreed that present job opportunities were good, and 47 percent who disagreed. Mine expansion would likely increase competition for available labor and the existing low-income labor pool would become smaller.

The elderly. The impact of the population influx would affect senior citizens in two important ways. The miners, with their average salary of over \$17,000, would cause some inflation in the costs of goods and services. Senior citizens on fixed incomes would be less able to cope with inflated prices. This inflation is noticeable now in the cost of housing. Given the present shortage of housing, future population influxes will greatly increase

Table G-46

Years of Residence in Sheridan County, by Principal Effect of the Decker Mine on Sheridan
(percent)

| What has been the principal effect of the strip mining industry on Sheridan (select one)? | Years of Residence in Sheridan County | | | | | Total |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------|-------------------------------|---------------|---------------------------|-------|
| | under 1 year | more than 1, less than 3 years | 3 but less than 5 years | 5-10 years | much or all of life | |
| No impact | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.8 |
| Economically beneficial | 1.7 | 2.5 | 4.2 | 5.0 | 20.8 | 34.2 |
| Economically beneficial but socially detrimental | 0.0 | 0.0 | 0.0 | 0.0 | 5.8 | 5.8 |
| Increased rents and living costs | 2.5 | 1.7 | 4.2 | 4.2 | 24.2 | 36.7 |
| Crowded service and recreational facilities | 0.0 | 0.0 | 0.0 | 0.0 | 4.2 | 4.2 |
| Addition of more educated and interesting people | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | 1.7 |
| Improvement in the general housing situation, e.g., construction of new housing and remodeling of old | 1.7 | 0.0 | 0.0 | 0.0 | 0.8 | 2.5 |
| Don't know | 0.0 | 0.8 | 0.8 | 2.5 | 8.3 | 12.5 |
| Declined to respond | 0.0 | 0.0 | 0.8 | 0.0 | 0.8 | 1.7 |
| Total | 5.8 | 5.0 | 10.0 | 11.7 | 67.5 | 100.0 |

the competition for housing. Senior citizens will be at a disadvantage. As housing costs rise, those senior citizens who rent may look to the city and county for assistance with housing.

The second major area of impact would be a change in the character of Sheridan. What we mean here is that Sheridan's population of older people has already stopped growing as a result of the housing situation described above, and that this population will begin to decline in the next two years and continue doing so for many years to come. Sheridan is now in the early stages of changing from a haven for retired ranchers and farmers to a place where it will be increasingly difficult for older people to enjoy the controlled, relaxed, and rural-service-town atmosphere which had been its main attraction before the town's recent growth cycle began. In a word, as the town becomes bigger, more urbanized, more impersonal, and still more expensive, retired people will tend to settle elsewhere and natural attrition will reduce the number of Sheridan's senior citizens.

Ranchers in Montana. Even though the coal issue has sharply divided some areas, some residents are making a real effort to keep alive the old social relationships, the old neighboring and helping patterns. These people feel that these good relationships which have been nurtured in the past have kept the communities together in hard times before. One informant said that in times of crisis her community had always drawn closer together and had gained strength from them. Now, she said, the coal issue is tearing the community asunder.

There is a feeling that local BLM and Forest Service people are good and dedicated and have the interest of the local people at heart. One informant said, however, she feels that if they are against strip mining

and coal development they may not be able to express this to their superiors for fear of putting their positions in jeopardy. She thought the pro-development personnel would have more freedom to speak out and influence their superiors.

Almost every rancher expressed fear that the large corporations will get control of the land. This may account for the fact that more people are leasing rather than selling. If the land is leased and mined the rancher loses control over its use for many years but he does not relinquish the ultimate control of it. He may be content with knowing that his children will later at least have the choice of deciding what they want to do with the land. If he sold it now he would forego them that choice.

A few people have said they believe the regional offices of the BLM and Forest Service know now what they have planned for their lands in this area and the former wonder why the agencies do not tell the people now rather than placating them with more studies. This, these informants lamented, is just one more source of information that is withheld from the people concerned, the people who have momentous decisions ahead of them. If the feds would come out and tell their plans people could make better choices, they said.

The old practice of "that's his business" that was part of the Golden Rule here and the attitude of "I'll go it alone" had a survival value in the past but, just like some biological adaptations and overspecializations, these may now cause the species to become extinct. Some are now saying they believe neighbors should tell each other if they are going to lease and the exact terms of the lease. Ranchers have traditionally cooperated in other things but now perhaps it is in their best interest to cooperate in

business dealings. In fact, one large group of ranchers in the Quietus-Sayle area did go together and draw up a lease agreement with all agreeing on the terms of the agreement, and then they all signed the same lease agreement with the broker who leased their land.

A couple of informants have said that, if other people are leasing to coal companies, that is a good indication of how they feel, meaning they are showing that they are for coal development because they have leased their land. Some people have questioned how a person can lease his land and still be against development. They have told us that anyone in that position is a liar. One informant said:

What irritates me is that some people will tell you one thing and then do the other. If someone has said all along that they were against coal development and then they turn around and lease it shows you their real colors.

Another informant says it makes him very angry "to hear people mouth principles and then have them do the opposite." Few of the residents show that they are aware that people's attitudes toward something and their behavior concerning it are often two different things.

Most people have not read the Decker-Birney report because they have heard of a few of the conclusions and recommendations, they feel this is a final statement of fact, and they are not going to change or influence it--so why try? Why even read it? People say there is less and less discussion of the coal issue in most of the communities now because most feel that the decisions have been made. A couple informants have said, "I don't waste my time trying to change something as foregone as this coal development. I just try to work with it now." So many people are interpreting what they read and hear as final instead of preliminary in any sense. They are letting their feeling of "inevitability" color all information and decisions.

One young rancher felt the coal industry would offer him the opportunity to stay in the area if he did not make it in ranching. He said it is very difficult for a person starting up to be successful in ranching and he would rather have the chance to stay in his area and work for a coal company if he went broke ranching rather than have to move to a city and work at something else.

Some ranchers believe those who think they can stay and continue ranching with full-scale coal activity have a rather "pollyana-ish" attitude. This is evident, they say, in the fact that people are leasing rather than selling and moving out of the area to where they can ranch undisturbed. Critics of this optimistic attitude say that if people really comprehended the coming impact they would not for a minute believe they could live with it and therefore would not lease.

One man said the coal issue is making people reassess what they want out of life. Before, they never really had a choice or felt they had a choice, but now they do. They can actually choose whether they want to (1) sell out and retire and know they will have enough for a good retirement, (2) trade for a much bigger ranch, or (3) move to another area. This is very hard on some people, just suddenly having the opportunity to choose. The same person said some ranchers may be tied to the land but not wedded to it. The choices that people are making now might indicate which it is.

There may be some second thoughts about trading up, i.e., trading a ranch to a coal company for a larger ranch that the company will buy for the person somewhere else. Many ranchers have said this would be the ideal thing to do, that if they could make a good enough deal and get a much

better and bigger ranch than they now have there would be no question that they would uproot and move to a new place. The economics of the situation would facilitate severing any social ties they might have to their old community. One lawyer interviewed who represents some ranchers in the study area who are thinking of selling said that when he confronts them with some of the possible problems of trading up it makes them think twice. He said he has pointed out the problems of running more cattle and the chance the rancher would have to depend on more help at a time when it is almost impossible to hire a good hand. He says they would not have more money, only more assets to worry about. If they get some irrigated or farmland, it takes tremendous capital investments to improve or just to maintain and operate the equipment, not to mention the work and long hours involved. Also, the only attractive land which is available is probably hundreds of miles away. He repeated that many go away thinking twice about it.

Miners. Miners in the survey were the strongest supporters of expansion of the Decker mine. Seventy percent of the miners in the survey agreed that there would be more jobs available in Sheridan and that Sheridan could handle the impact. They reported more concern about housing availability and less concern about rising costs than did the rest of those surveyed.

Other Sheridan residents. So far coal-related development has been extensive enough to help local businessmen but not so large scale as to attract chain stores and discount centers. Some small family businessmen were fearful that increasing coal development would bring unwanted competition, but other young businessmen saw potential opportunities for moving up to newly created managerial positions. Respondents in "blue collar" and

clerical jobs supported expansion of the mine more strongly than "professionals" did, but about the same as the average person in the survey.

Housing

Since there are virtually no rentals available nor moderately priced houses for sale at this time, and little construction underway, the addition of any work force to the area would put a severe strain on a housing situation that most residents are already describing as "terrible." Preliminary information from the county's housing survey showed fewer than 30 available housing units in Sheridan. When that survey is completed more accurate information will be available.

Mobile home parks are now under construction, and there is some remodeling and new building, but all of that seems needed to ease only the existing pressure for housing. Table G-47 projects the number of housing units needed to accommodate the incoming workers. In 1976 there would be a need for 476 new housing units in Sheridan County if both mines are started.

Most residents, 81 percent, said that they expect the price of housing to go up sharply if the mine expansion is approved; and, as indicated in table G-48, 69 percent expect that the biggest change in Sheridan from the mine expansion will be increased housing costs (22 percent) or decreased housing availability (47 percent). Some landlords said that this would be a change for the better, whereas some property owners would be pleased to see the value of their property rise. Since 86 percent of the residents reported that they expect to remain in the area the rest of their lives, they apparently would not profit directly from the increased valuation.

Table G-47

Number of New Decker Employees and Their Housing Demands in Sheridan County

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980- 2000</u> |
|----------------------------------------------------------------------|-------------|-------------|-------------|-------------|-----------------------|
| If only the North Extension Mine opens: | | | | | |
| Number of new employees ¹ | 265 | 175 | 165 | 165 | 155 |
| Number of housing units needed in Sheridan County ² | 238 | 157 | 148 | 148 | 139 |
| If only the East Decker Mine opens: | | | | | |
| Number of new employees | 265 | 345 | 605 | 595 | 637 |
| Number of housing units needed in Sheridan County | 238 | 310 | 544 | 535 | 573 |
| If both mines open: | | | | | |
| Number of new employees | 530 | 520 | 770 | 760 | 792 |
| Number of housing units needed in Sheridan County | 476 | 467 | 692 | 683 | 712 |

¹Includes both mine employees and full-time derived employees.

²Assumes that 90 percent of the employees will live in Sheridan County and that each employee will generate a demand for one housing unit.

Table G-48

Years of Residence in Sheridan County, by Anticipated Effect of Expected Population Influx
(percent)

| If 250 new families (at least 1,000 people) move into Sheridan in the next two years, which of the following items would be most affected (select one)? | Years of Residence in Sheridan County | | | | Total |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------|-------------------------|------------|-------|
| | under 1 year | more than 1, less than 3 years | 3 but less than 5 years | 5-10 years | |
| Housing costs | 0.8 | 0.8 | 2.5 | 0.0 | 17.5 |
| Other living costs | 0.0 | 0.8 | 0.0 | 1.7 | 5.8 |
| Employment opportunities | 0.0 | 0.0 | 0.8 | 0.8 | 5.0 |
| Recreational opportunities | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 |
| Community services (e.g., schools, police) | 0.0 | 1.7 | 0.0 | 5.0 | 3.3 |
| Relationships between groups of people | 0.8 | 0.0 | 0.0 | 0.0 | 1.7 |
| Housing availability | 4.2 | 1.7 | 6.7 | 4.2 | 30.8 |
| Health-related services | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Declined to respond | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 |
| Total | 5.8 | 5.0 | 10.0 | 11.7 | 67.5 |
| | | | | | 100.0 |

Calling attention to another aspect of housing impact, an employment officer said, "We could provide most of the construction force for expansion except for housing." In the same vein, it should be noted that among the 37 percent who agreed that Sheridan could handle the number of people that would come with mine expansion were many who qualified their assurance with, "except for housing."

There would surely have to be more mobile home parks constructed in the county where regulations are less restrictive if the Sheridan area would have to provide most of the housing for the proposed mine expansion. Since location of these parks is generally not dictated by the availability of classroom space in schools, irritations already caused by busing students out of their neighborhoods would become more acute. As pressures grow for more school funds, residents who own single family homes would feel they are carrying an unfair tax burden because trailer owners would be paying lower property taxes. The traditions of most people owning their single family homes would further conflict with those of trailer residents, many of whom would harbor resentments of their own for not being given the opportunity to live in single family homes.

The impact on fixed-income and low-income residents would increase sharply since no subsidized housing nor other low-income housing is near construction. The cost of housing would probably make Sheridan an unlikely place for retirement except for the well-to-do.

Although not all of the increased housing costs and decreased housing availability would be caused by expansion of the Decker mine, most people would blame the situation on that expansion. The effects of other developments such as the impact from Lake DeSmet and Gillette are not so

concentrated nor obvious, and the impact from other proposed developments closer to Sheridan would come after the Decker expansion had borne the heavy burden of being first. Also, these other Wyoming developments would be considered more desirable because all of the tax revenue would be Wyoming's.

Water and Sewage

The additional population may not overload the total capacity of either the water treatment or sewage treatment plants. This impact will depend on the distribution of the new arrivals in Sheridan County. However, the water distribution lines and the sewage collection lines are already inadequate in some sections of Sheridan. Additional housing in these sections would aggravate the existing situation.

The study of Sheridan's water and sewage system should provide accurate information on the present loading and potential capacity of the distribution and collection systems. This study will be completed in January 1976.

Transportation

No matter where the additional workers would live, the road between Decker and Sheridan would receive the greatest impact of increased travel, although I-90 to Billings would be more heavily traveled as more people turned to Billings for service.* Since "streets and roads" was named most often as a service that needed improvement right now, it is not surprising that 57 percent of the survey respondents said that streets and roads would be detrimentally affected by mine expansion.

*More information will soon be available from the Montana State Highway Department's survey.

Schools

Using the population projections developed in this report it is possible to make predictions of the impact the incoming school age population will have on Sheridan. Based on past patterns, it is assumed that all incoming school age children will live in School District #2. The error in this assumption should be negligible.

Table G-49 gives the number of school age children in Sheridan and Big Horn counties. The Sheridan County total is divided into the number of children associated with the North Extension and the East Mine. The demographic section of the report explains in detail the assumptions behind these projections.

If both mines open, School District #2 would have to find room for approximately 286 new students during the 1976-1977 school year. As previously noted, the superintendent estimates that district schools have room for a total of about 300 children. It is important to note that at least half of this available space is in the high school. It is extremely unlikely that the incoming children will mesh with the vacant spaces. Some crowding in excess of the maximum acceptable capacity of classrooms would result. Maximum acceptable classroom capacity in Sheridan is listed as 27 for grade schools and 25 for high schools. Using the standard of 18.2 children per teacher,* the Sheridan schools are inadequate. Table G-50 applies this adequacy standard to last year's District #2 enrollment. The

"Capital Facilities Study: Powder River Basin," by Intermountain Planners and Wirth-Berger Associates, prepared for the Wyoming Department of Economic Planning and Development, April 1, 1974, page 35.

Table G-49

**Projected School Age Population Increase and Resulting Need for Additional Classrooms/Teachers
at Maximum Capacity and to Meet Adequacy Standards for New Students -**

Sheridan and Big Horn Counties

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> | <u>After 1980</u> |
|-----------------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|-----------------------|
| <u>Sheridan County</u> | | | | | | |
| 1. If both mines open: | | | | | | |
| a. Total additional school age population | 286 | 282 | 471 | 483 | 504 | 504 |
| b. Classrooms/teachers needed at maximum capacity ¹ | 11 | 11 | 19 | 19 | 20 | 20 |
| c. Classrooms/teachers needed to meet adequacy standards ² | 16 | 15 | 26 | 27 | 27 | 27 |
| 2. If only the North Extension of the West Decker Mine opens: | | | | | | |
| a. Total additional school age population | 154 | 110 | 104 | 104 | 98 | 98 |
| b. Classrooms/teachers needed at maximum capacity | 6 | 4 | 4 | 4 | 4 | 4 |
| c. Classrooms/teachers needed to meet adequacy standards | 9 | 6 | 6 | 6 | 5 | 5 |
| 3. If only the East Decker Mine opens: | | | | | | |
| a. Total additional school age population | 132 | 172 | 367 | 379 | 406 | 406 |
| b. Classrooms/teachers needed at maximum capacity | 5 | 7 | 15 | 15 | 16 | 16 |
| c. Classrooms/teachers needed to meet adequacy standards | 7 | 9 | 20 | 21 | 22 | 22 |
| <u>Big Horn County</u> | | | | | | |
| Total additional school age population if both mines open | 32 | 31 | 53 | 54 | 56 | 56 |
| Classrooms/teachers needed at maximum capacity | 1 | 1 | 2 | 2 | 2 | 2 |
| Classrooms/teachers needed to meet adequacy standards | 2 | 2 | 3 | 3 | 3 | 3 |

¹Maximum acceptable capacity per classroom of 27 students

²18.2 children per teacher (source: Government Printing Office publication D4EW(OE) 73-11402 by Betty Foster as cited in Intermountain Planners and Wirth-Berger Associates "Capital Facilities Study: Powder River Basin" for the Wyoming Department of Economic Planning and Development, April 1, 1974, page 35).

Table G-50

**Additional Teachers and Classrooms Needed to Meet Adequacy Standards¹ during School Year 1975-1976 -
School District #2, Sheridan, Wyoming**

| <u>School²</u> | <u>Grades</u> | <u>Number of Existing Teaching Stations</u> | <u>Number of Classroom Teachers</u> | <u>1974-1975 Enrollment</u> | <u>Additional Teachers and Classrooms Needed to Meet Adequacy Standards</u> |
|------------------------------------------------------------------------------------|---------------|---------------------------------------------------------|---------------------------------------------|---------------------------------|-------------------------------------------------------------------------------------------------|
| Coffeen | K-6 | 19 | 19 | 411 | 3 |
| Highland Park | K-6 | 13 | 13 | 373 | 7 |
| Linden | K-6 | 13 | 13 | 352 | 6 |
| Taylor | K-6 | 7 | 7 | 165 | 1 |
| Woodland Park | K-6 7-8 | 7 4 | 7 4 | 198 65 | 4 - |
| Central School | 7-8 | 18 | 18 | 456 | 7 |
| High School | 9-12 | 44 | 56 | 1,137 | 73 |
| Total number of additional teachers required to meet adequacy standards | | | | | 35 |

¹18.2 children per teacher, cited in "Capital Facilities Study: Powder River Basin" by Intermountain Planners and Wirth-Berger Associates, for the Wyoming Department of Economic Planning and Development, page 35.

²Acme, Beckton, and Story schools have been excluded because they have more than one grade in a classroom.

³Indicates only the number of additional teachers required to meet 18.2 students per teacher.

district presently needs a total of 35 additional teachers to serve the school age population at an adequate pupil/teacher ratio. If both proposed Decker mines open, the district will require an additional 16 teachers during the 1976-1977 school year to serve the incoming students at an adequate pupil/teacher ratio (see table G-52). Only 11 teachers would be needed if the pupil/teacher ratio was maintained at the maximum acceptable level.

School District #2 has several options in dealing with this potential increased enrollment:

1. The district may elect to do nothing, accepting classrooms with a pupil/teacher ratio at or above the maximum acceptable level.
2. The district may buy or rent mobile classrooms to supplement existing facilities.
3. The district may build new classrooms. This option is limited both by the district's legal ability to spend for capital facilities and the voters' willingness to accept increased indebtedness. As noted before, School District #2 is very close to the limit of its legal indebtedness. The district may look to other sources, such as the states of Montana and Wyoming and the coal companies, for capital funds.

If the district chooses to do nothing now, it faces two years of operation at its maximum capacity. Then in 1978, if both mines open, the mine-related school age population will be 471. This number will exceed the district's maximum capacity; thus, if the district does nothing during the next two years, it may be able to accommodate students in overcrowded conditions. However, in the years thereafter, additional facilities will be mandatory. People in Sheridan already expect that Decker's expansion

Table G-51

Total Number of Teachers Needed to Meet Adequacy Standards Now and In
the Future - School District #2, Sheridan, Wyoming

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> | <u>After 1980</u> |
|------------------------------------------------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|-----------------------|
| Total additional teachers presently needed to meet adequacy standards ¹ | 35 | 35 | 35 | 35 | 35 | 35 |
| Number of additional teachers needed to serve new students at the adequacy standard: | | | | | | |
| if only the East Decker Mine opens | 7 | 9 | 20 | 21 | 22 | 22 |
| if only the North Extension opens | 9 | 6 | 6 | 6 | 5 | 5 |
| if both mines open | 16 | 15 | 26 | 27 | 27 | 27 |
| Total additional teachers needed to serve present students and new students if both mines open | 51 | 50 | 51 | 52 | 52 | 52 |

¹See table G-50

will cost them more to support the schools. About 79 percent of our respondents opined that increases in staff and facilities will make it necessary for taxes to go up during the next two years. Also, as one of these respondents said:

Newcomers will live in mobile homes that are not taxed as high as other residents, so we (old-timers) will have to pay extra for school expansion.

Squirrel Creek elementary school (grades 1-8) at Decker has a 1975-1976 enrollment of seven. Last year there were 15 students but three graduated, four moved away from ranches which were bought for the Decker mine, and one mine family (two students) moved to Wyoming. This fall a first-grader brought the enrollment to seven.

In the survey of Sheridan residents, 72 percent of the respondents indicated satisfaction with grade schools and 63 percent indicated satisfaction with the high school. When they were asked how the influx of 250 families during the next two years would affect the grade schools and the high school, 72 percent indicated that the influx would be detrimental to the grade schools and 65 percent indicated that the influx would be detrimental to the high school (see table G-52).

It is not possible to accurately predict the impact of the projected influx on the quality of education in School District #2. It is reasonable to expect a strong reaction to the degradation of a community service with which the residents are currently satisfied. It is also reasonable to expect increased dissatisfaction with busing as more students are bused to equalize school enrollment.

Table G-52

Years of Residence in Sheridan County, by Expected Effect of Population Influx on Schools
(percent)

| If 250 new families (at least 1,000 people) move into Sheridan during the next two years, how would schools be affected? | Years of Residence in Sheridan County | | | | |
|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------|-------------------------------|---------------|---------------------------|
| | under 1 year | more than 1, less than 3 years | 3 but less than 5 years | 5-10 years | much or all of life |
| Increased and/or improved | 0.0 | 0.0 | 0.0 | 0.0 | 3.4 |
| Decreased and/or detrimental to | 2.5 | 3.8 | 7.1 | 8.8 | 46.7 |
| Unaffected | 1.7 | 0.4 | 0.0 | 2.1 | 6.2 |
| Don't know | 1.7 | 0.8 | 2.5 | 0.8 | 9.6 |
| Declined to respond | 0.0 | 0.0 | 0.4 | 0.0 | 1.7 |
| Total | 5.9 | 5.0 | 10.0 | 11.7 | 67.6 |
| | | | | | 100.0 |

Recreation

The population influx would place increased demand on recreational facilities. The residents of Sheridan who are accustomed to uncrowded outdoor recreational facilities expect to feel the greatest impact. For example, many informants expressed the concern that outdoor recreation will become too crowded and hunting unsafe. They pointed out that much private land is already being posted. People who were indoor recreationists account for the finding that 49 percent of Sheridanites believed that the anticipated impact of Decker's expansion would have no effect on recreational opportunities.

Public Safety

Law Enforcement

The population influx associated with the Decker mine would place additional strain on an already understaffed police department. Table G-53 indicates the number of additional officers that would be needed in Sheridan County to provide coverage at the average level in Wyoming. If both mines open, and if existing shortages are corrected, 14 additional officers will be needed in 1976. These officers will require equipment, e.g., patrol cars, and capital facilities, such as an enlarged jail. The survey respondents were asked how the arrival of 250 new families, at least 1,000 people, would affect police protection. Seventy-five percent indicated that this influx would make it harder to provide adequate police protection (see table G-54). In fact, many respondents pointed out that there is already an increase in the number of people who drink too much and a growing tendency of residents to lock their cars and houses. It is

Table G-53

Projected Need for Law Enforcement Officers, Sheridan County

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980</u> |
|-----------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|
| Projected Sheridan County population ¹ | 20,684 | 20,684 | 21,301 | 21,335 | 21,426 |
| Number of law officers required ² | 41 | 41 | 43 | 43 | 44 |
| Number of law officers currently in Sheridan County | 27 | 27 | 27 | 27 | 27 |
| Number of additional officers needed | 14 | 14 | 16 | 16 | 17 |

¹Projected Sheridan County population assumes that both mines will open.

²One law officer per 500, based on national and Wyoming averages as cited in Intermountain Planners and Wirth-Berger Associates, "Capital Facilities Study: Powder River Basin," for the Wyoming Department of Economic Planning and Development, page 52.

Table G-54

Years of Residence in Sheridan County, by Expected Effect of Population Influx on Police Protection

| If 250 new families (at least 1,000 people) move into Sheridan during the next two years, how would police protection be affected? | (percent) | | | | | |
|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------|-------------------------------|---------------|---------------------------|-------|
| | Years of Residence in Sheridan County | | | | | |
| | under 1 year | more than 1, less than 3 years | 3 but less than 5 years | 5-10 years | much or all of life | Total |
| Increased and/or improved | 0.0 | 0.8 | 0.8 | 0.8 | 3.3 | 5.8 |
| Decreased and/or detrimental to | 3.3 | 4.2 | 6.7 | 8.3 | 53.3 | 75.8 |
| Unaffected | 0.8 | 0.0 | 2.5 | 1.7 | 5.0 | 10.0 |
| Don't know | 1.7 | 0.0 | 0.0 | 0.8 | 4.2 | 6.7 |
| Declined to respond | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | 1.7 |
| Total | 5.8 | 5.0 | 10.0 | 11.7 | 67.5 | 100.0 |

also getting more difficult to cash a check without displaying identifying credentials. In general, the respondents believed that their feelings of safety would depend largely upon what kinds of people move into the Sheridan area--and that remains to be seen.

Fire Protection

If the population increase stimulates building or adds mobile homes in an area with inadequate waterlines, the fire protection in these areas may become critically inadequate. Assuming that many new mobile homes will be located outside the city limits, a great strain will be put on that area's fire protection facilities. These facilities, which are located at the airport, would need to be strengthened. When the city engineer's study of existing water mains is completed, the city should have sufficient information to judge the impact of new construction.

Social and Welfare Services

The population influx would aggravate the already serious housing problem of welfare recipients. According to the welfare department officials, the new workers are outbidding welfare recipients for the small number of available houses. This problem will become more serious as more new workers move into Sheridan County.

Health Services

The existing health care personnel and facilities should be adequate to take care of the population increase associated with the Decker expansion. However, this influx would raise the area population to the adequacy limit

for the hospital. As noted before, residents of surrounding counties use the Sheridan hospital. If these counties experience substantial population increase without a corresponding increase in health care facilities, the Sheridan hospital will be inadequate to handle the demand. The hospital's capacity, not the number of health care personnel, is at present the main limiting factor in determining health care adequacy in Sheridan County.

Table G-55 presents the number of hospital beds needed to adequately care for the projected population of Sheridan County. It is not within the scope of this study to project the demand that will be placed on the Sheridan hospital by residents of other counties. This demand may be substantial, given the shortage of medical facilities in surrounding counties.

The ambulance service would experience increased demand. If the Decker Coal Company maintains an ambulance for its employees at the mine site, the existing ambulance service in Sheridan should be adequate.

Table G-55

Projected Need for Hospital Beds, Sheridan County

| | <u>1976</u> | <u>1977</u> | <u>1978</u> | <u>1979</u> | <u>1980 & Beyond</u> |
|-----------------------------------------------------------------------------------------|-------------|-------------|-------------|-------------|------------------------------|
| Projected population of Sheridan County ¹ | 20,684 | 20,684 | 21,301 | 21,335 | 21,426 |
| Number of hospital beds needed for Sheridan County ² | 82 | 82 | 85 | 85 | 86 |
| Number of beds available for patients of surrounding counties. ³ | 7 | 7 | 4 | 4 | 3 |

¹See the demographic section of the larger report.

²Adequacy standard of four beds per 1,000 population, based on the national average of 1,183 patient days per year per thousand of population, multiplied by roughly 82 percent average occupancy rate for each hospital.

³Beds in excess of the number needed to adequately serve the population of Sheridan County.

Sampling and Survey Procedures

Sampling Procedures

The survey was limited to those residents living within the city of Sheridan. It was assumed that the city of Sheridan would bear major impact from a population influx into the county.

Numerous lists of residents of Sheridan were considered the possible basis for a random sample of the city. None was found to be complete. It was decided to use the 1974 Polk city directory of residents in Sheridan.

A sample size of approximately 3 percent of all residential units in Sheridan equaled 120 respondents. These respondents were selected in accordance with standard random sample selection procedure. A sample of 120 for the population of Sheridan provides data at the 95 percent confidence interval which is between the .05 and 0.1 precision levels.

Survey Procedures

The survey items were developed according to the needs of the study and according to information gathered in previous interviews in the area. The preliminary draft of the survey was pretested in Sheridan by three interviewers from July 27 to July 31, 1975. The survey was pretested on randomly selected residents and selected knowledgeable individuals in the community. Information gathered during the pretest was used to improve the survey form and content.

The survey was administered by three interviewers (Raymond Gold, Alice Sterling, and James Devitt) during August 6-16, 1975. The survey

was administered to any adult resident, i.e., over 18 years old, in the living unit. Interviews were conducted both during the day and the evening so that working individuals would not be excluded. Replacements for respondents were selected after a reasonable effort had been made to reach them. The procedure used was uniformly applied and designed to minimize bias.

The results of the survey were coded for computer analysis by the interviewers. After key punching and verification, the data was run using the CROSSTABS program. Four items, questions 4, 5, 31, and 89, were cross-tabulated against all other items. The total of responses to each item on the questionnaire are presented in Appendix G beginning on page G-188. It is physically impractical to present all data from the computer output. There are over 1,500 tables on hand at the Institute for Social Research, with literally millions of comparisons and cross-tabulations possible from the survey data.

Questionnaire

Interviewer _____

Date _____

_____ 1. Your age: _____ (2 digits coded as 1 digit)

1. under 20
2. 20-29
3. 30-39
4. 40-49
5. 50-59
6. 60-69
7. 70 and over
9. declined to respond

_____ 2. Sex:

1. male
2. female
9. declined to respond

_____ 3. Occupation of head of household:

1. professional/managerial/supervisory
2. retired
3. blue collar
4. ranch/farm worker
5. clerical
6. not employed (other than retired)
9. declined to respond

_____ 4. Head of household's employer:

1. self-employed
2. government
3. mine-related/Decker
4. mine-related/Big Horn
5. mine-related/other (specify _____)
6. other nongovernment
7. NA
9. declined to respond

_____ 5. Your years of residence in Sheridan County:

1. under 1 year
2. more than 1, less than 3 years
3. 3 but less than 5 years
4. 5-10 years
5. much or all of my life
9. declined to respond

_____ 6. How long do you plan to remain in the Sheridan area?

1. 1 year or less
2. more than 1 but less than 3 years
3. 3 years or more but less than 5 years
4. 5-10 years
5. the rest of my life
6. don't know
9. declined to respond

_____ 7. Marital status of respondent:

1. married, no dependent children
2. married, dependent children
3. not married, no dependent children
4. not married, dependent children
9. declined to respond

_____ 8. Type of home:

1. separate single family home
2. apartment, including duplex-fourplex
3. mobile home (mobile home park)
4. mobile home on private lot
5. other (specify) _____
9. declined to respond

_____ 9. Do you or does head of household own or rent your residence?

1. own
2. rent/lease
9. declined to respond

Indicate whether you agree, disagree, or are neutral about the following descriptions of living in Sheridan:

1. agree
2. disagree
3. neutral
9. declined to respond/don't know

_____ 10. job opportunities are good

_____ 11. people are my kind of people

_____ 12. good shopping facilities

_____ 13. good recreational opportunities

_____ 14. good community service, e.g., schools, law enforcement

_____ 15. available good housing

_____ 16. a good place to raise children

_____ 17. a good place to retire

_____ 18. How would you describe the people you (i.e., head of household) usually associate with after work?

1. geographical group (such as a neighborhood)
2. work-related
3. voluntary associations, e.g., church-related and secular clubs
4. family-related, including own and other families such as parents of children's friends
5. friends
6. informal interest groups, e.g., groups related to hobbies, sports, card playing
7. other (specify) _____
8. don't know
9. declined to respond

_____ 19. In Sheridan, which one of these services most needs to be improved?

1. schools
2. police
3. fire
4. health care
5. water/sewage
6. streets/roads
7. city government
8. county government
9. declined to respond/don't know

_____ 20. Which would be your second choice?

1. schools
2. police
3. fire
4. health care
5. water/sewage
6. streets/roads
7. city government
8. county government
9. declined to respond/don't know

_____ 21. Which one of the above services would you be willing to support with more taxes?

1. schools
2. police
3. fire
4. health care
5. water/sewage
6. streets/roads
7. city government
8. county government
9. declined to respond/none

_____ 22. Which would be your second choice?

1. schools
2. police
3. fire
4. health care
5. water/sewage
6. streets/roads
7. city government
8. county government
9. declined to respond/none

_____ 23. Do you know about plans to enlarge the Decker Coal Mine?

1. no
2. vaguely familiar (has heard about it)
3. knows something about it
4. quite familiar
9. declined to respond

_____ 24. Would you like to know more about these plans?

1. yes
2. no
3. neutral
9. declined to respond

_____ 25. If 250 new families (i.e., at least 1,000 people) move into Sheridan during the next two years, do you think that part of the increased cost of services should be paid by the industry that employs the new families?

1. agree
2. disagree
3. there will be no increased cost
4. neutral
9. declined to respond

_____ 26. Has the arrival of Decker coal miners and related workers increased the cost of housing more than it would have increased as part of a national trend?

1. yes
2. no
3. don't know
9. declined to respond

_____ 27. In Sheridan the average rent for an unfurnished, one-bedroom apartment, without utilities is:

1. about \$100 per month
2. about \$125 per month
3. about \$150 per month
4. about \$175 per month or over
5. don't know
9. declined to respond

- ____ 28. [To be answered only by and about respondents living in rented quarters.]
The rent for this residence is \$_____ per _____ for
[brief description of dwelling unit]_____
- ____ 29. Are you or others you know who rent paying higher rent than two years ago for the same place?
1. yes, slightly higher (less than 20 percent)
 2. yes, much higher (20 percent or more)
 3. no
 4. don't know
 9. declined to respond
- ____ 30. Property taxes in Sheridan are _____ taxes in comparable communities?
1. higher than
 2. the same as
 3. lower than
 4. don't know
 9. declined to respond
- ____ 31. State coal taxes and workers' income taxes at Decker Mine are payable to Montana although most of the workers live in Wyoming. Local taxes paid by the workers are property and sales taxes. What can be done about the service costs related to this situation?
1. Nothing; moreover, local business gains and present taxes should be sufficient to pay for service to these workers.
 2. Sheridan will have to levy a city sales tax.
 3. The coal industry should help pay these costs.
 4. The states of Montana and Wyoming should help pay these costs.
 5. The coal industry and the two states should jointly help pay these costs.
 9. declined to respond
- ____ 32. What people or institutions are making plans and decisions about growth in Sheridan? (Select the main one.)
1. city planning board
 2. county planning board
 3. state planning agency
 4. industry
 5. private agencies, such as Powder River Resource Council
 6. the federal government
 7. don't know
 9. declined to respond

_____ 33. How well are they doing it?

1. adequately
2. inadequately
3. it doesn't matter; planning is not effective
4. don't know
9. declined to respond

_____ 34. How satisfied are you with the public (i.e., your) input into these plans and decisions?

1. satisfied
2. dissatisfied
3. neutral
4. don't know
9. declined to respond

_____ 35. How satisfied are you with Decker's input into these plans and decisions?

1. satisfied
2. dissatisfied
3. neutral
4. don't know
9. declined to respond

Below are listed a number of public services available to residents of Sheridan. Would you please indicate whether you are satisfied at present with each of the following services:

1. satisfied
2. dissatisfied
3. neutral
4. don't know
9. declined to respond

_____ 36. grade schools

_____ 37. high school

_____ 38. police protection

_____ 39. hospital services

_____ 40. ambulance service

- _____ 41. sewage service
- _____ 42. water supply system
- _____ 43. shopping facilities
- _____ 44. streets and roads
- _____ 45. fire protection
- _____ 46. city government
- _____ 47. county government
- _____ 48. mental health services
- _____ 49. recreation facilities
- _____ 50. service to senior citizens
- _____ 51. dental services
- _____ 52. medical services

If 250 new families (at least 1,000 people) move into Sheridan during the next two years, and assuming that Sheridan's city and county finances will be about what they are now, how would each of the following services be affected? It would be:

- 1. increased and/or improved
- 2. decreased and/or detrimental to
- 3. unaffected
- 4. don't know
- 9. declined to respond

- _____ 53. grade schools
- _____ 54. high school
- _____ 55. police protection
- _____ 56. hospital services
- _____ 57. ambulance service
- _____ 58. sewage service
- _____ 59. water supply system
- _____ 60. shopping facilities
- _____ 61. streets and roads
- _____ 62. fire protection
- _____ 63. city government
- _____ 64. county government
- _____ 65. mental health services
- _____ 66. recreation facilities
- _____ 67. service to senior citizens
- _____ 68. dental services
- _____ 69. medical services

If 250 new families (at least 1,000 people) move into Sheridan, what effect would that have on the following aspects of your life?

1. increase or improve
2. decrease or be detrimental to
3. no effect
4. don't know
9. declined to respond

_____ 70. better and/or more secure job opportunities

_____ 71. recreational opportunities

_____ 72. enjoyment of life in general

_____ 73. feelings toward Sheridan

_____ 74. feeling being a part of the community of Sheridan

_____ 75. feelings of safety

If 250 families (at least 1,000 people) move into Sheridan, would you agree, disagree, or be neutral toward the following statements?

1. agree
2. disagree
3. neutral
4. don't know
9. declined to respond

_____ 76. There would be more jobs in Sheridan.

_____ 77. All of us would have to pay more taxes for schools.

_____ 78. Local people would still control decisions.

_____ 79. Sheridan would be a better place to live.

_____ 80. The newcomers would be easily accepted into the community.

_____ 81. The price of housing would go up sharply.

_____ 82. Sheridan could handle that many more people..

83. We are interested in learning about social change in Sheridan. Which one of the following items has changed most in the past three years?

1. housing costs
2. other living costs
3. employment opportunities
4. recreational opportunities
5. community services (e.g., schools, police)
6. relationships between groups of people
7. health-related services
8. don't know
9. declined to respond

84. Has this change been for the better or worse?

1. better
2. worse
3. neither better nor worse
4. don't know
9. declined to respond

85. If 250 families (at least 1,000 people) move into Sheridan in the next two years, which of the following items would be most affected (select one)?

1. housing costs
2. other living costs
3. employment opportunities
4. recreational opportunities
5. community services (e.g., schools, police)
6. relationships between groups of people
7. housing availability
8. health-related services
9. declined to respond

86. Would it be affected for the better or worse?

1. better
2. worse
3. neither better nor worse
4. don't know
9. declined to respond

87. Have the workers from the present Decker Mine had any effect on Sheridan?

1. yes--I am aware of them
2. no--I haven't noticed them
3. don't know
9. declined to respond

88. What has been the principal effect of the Decker Coal Company on Sheridan (select one)?

1. no impact
2. economically beneficial
3. economically beneficial but socially detrimental
4. increased rents and living costs
5. crowded service and recreational facilities
6. addition of more educated and interesting people
7. improvement in the general housing situation, e.g., construction of new housing and remodeling of old
8. don't know
9. declined to respond

89. Everything considered, I believe that approval should be granted to expand the Decker Mine.

1. yes
2. no
3. neutral
4. I need to know more about the expansion plans and the likely consequences
5. don't know
9. declined to respond

-- August 1975

Questionnaire Responses (p. G-188 ff.)

The following pages report the total of responses to each item on the questionnaire. Four items, questions 4, 5, 31, and 89, were cross-tabulated against all other items. A few of these tabulations are presented in tables throughout the text. (tables G-36, G-37, G-40, G-41, G-42, G-43, G-44, G-45, G-46, G-48, G-52, G-54)

QUESTIONNAIRE CONCERNING PROPOSED EXPANSION OF THE DECKER MINE:

ADMINISTERED TO A RANDOM SAMPLE OF SHERIDAN RESIDENTS

| Response Choices | | Percent Making Each Choice |
|-----------------------------------------------|--|----------------------------------|
| Your age: | | |
| under 20 | | 1.7 |
| 20-29 | | 23.3 |
| 30-39 | | 16.7 |
| 40-49 | | 21.7 |
| 50-59 | | 8.3 |
| 60-69 | | 12.5 |
| 70 and over | | 15.8 |
| declined to respond | | 0.0 |
| Sex: | | |
| male | | 44.2 |
| female | | 55.8 |
| declined to respond | | 0.0 |
| Occupation of head of household: | | |
| professional/managerial/supervisory | | 30.8 |
| retired | | 23.3 |
| blue collar | | 32.5 |
| ranch/farm worker | | 0.8 |
| clerical | | 8.3 |
| not employed (other than retired) | | 4.2 |
| declined to respond | | 0.0 |
| Head of household's employer: | | |
| self-employed | | 17.5 |
| government | | 14.2 |
| mine-related/Decker | | 8.3 |
| mine-related/Big Horn | | 1.7 |
| mine-related/other (specify) | | 0.8 |
| other nongovernment | | 32.5 |
| NA | | 21.7 |
| declined to respond | | 3.3 |
| Your years of residence in Sheridan County: | | |
| under 1 year | | 5.8 |
| more than 1, less than 3 years | | 5.0 |
| 3 but less than 5 years | | 10.0 |
| 5-10 years | | 11.7 |
| much or all of my life | | 67.5 |
| declined to respond | | 0.0 |

| Response Choices | Percent Making Each Choice |
|-----------------------------------------------------------------------------------------------------------------|----------------------------------|
| How long do you plan to remain in the Sheridan area? | |
| 1 year or less | 2.5 |
| more than 1 but less than 3 years | 1.7 |
| 3 years or more but less than 5 years | 1.7 |
| 5-10 years | 1.7 |
| the rest of my life | 85.8 |
| don't know | 6.7 |
| declined to respond | 0.0 |
| Marital status of respondent: | |
| married, no dependent children | 34.1 |
| married, dependent children | 40.0 |
| not married, no dependent children | 18.3 |
| not married, dependent children | 7.5 |
| declined to respond | 0.0 |
| Type of home: | |
| separate single family home | 82.5 |
| apartment, including duplex-fourplex | 12.5 |
| mobile home (mobile home park) | 4.2 |
| mobile home on private lot | 0.0 |
| other (specify) | 0.8 |
| declined to respond | 0.0 |
| Do you or does head of household own or rent your residence? | |
| own | 73.3 |
| rent/lease | 26.7 |
| declined to respond | 0.0 |
| Indicate whether you agree, disagree, or are neutral about the following descriptions of living in Sheridan: | |
| job opportunities are good | |
| agree | 36.7 |
| disagree | 46.7 |
| neutral | 13.3 |
| declined to respond/don't know | 3.3 |
| people are my kind of people | |
| agree | 84.2 |
| disagree | 7.5 |
| neutral | 8.3 |
| declined to respond/don't know | 0.0 |

Response Choices

Percent
Making
Each Choice

| | |
|------------------------------------------|------|
| good shopping facilities | |
| agree | 65.8 |
| disagree | 25.0 |
| neutral | 9.2 |
| declined to respond/don't know | 0.0 |

| | |
|------------------------------------------|------|
| good recreational opportunities | |
| agree | 78.3 |
| disagree | 12.5 |
| neutral | 9.2 |
| declined to respond/don't know | 0.0 |

| | |
|--------------------------------------------------------|------|
| good community service, e.g., schools, law enforcement | |
| agree | 80.8 |
| disagree | 8.3 |
| neutral | 10.8 |
| declined to respond/don't know | 0.0 |

| | |
|------------------------------------------|------|
| available good housing | |
| agree | 7.5 |
| disagree | 83.3 |
| neutral | 7.5 |
| declined to respond/don't know | 1.6 |

| | |
|------------------------------------------|------|
| a good place to raise children | |
| agree | 91.7 |
| disagree | 5.0 |
| neutral | 3.3 |
| declined to respond/don't know | 0.0 |

| | |
|------------------------------------------|------|
| a good place to retire | |
| agree | 86.7 |
| disagree | 8.3 |
| neutral | 5.0 |
| declined to respond/don't know | 0.0 |

How would you describe the people you (i.e., head of household) usually associate with after work?

| | |
|--------------------------------------------------------------------------------------------------|------|
| geographical group (such as a neighborhood) | 10.8 |
| work-related | 18.3 |
| voluntary associations, e.g., church-related and secular clubs | 10.0 |
| family-related, including own and other families such as parents of children's friends | 22.5 |
| friends | 5.0 |
| informal interest groups, e.g., groups related to hobbies, sports, card playing | 25.0 |
| other (specify) | 6.7 |
| don't know | 1.7 |
| declined to respond | 0.0 |

Response Choices

Percent
Making
Each Choice

In Sheridan, which one of these services most needs to be improved?

| | |
|------------------------------------------|------|
| schools | 14.2 |
| police | 17.5 |
| fire | 2.5 |
| health care | 2.5 |
| water/sewage | 6.7 |
| streets/roads | 24.2 |
| city government | 15.8 |
| county government | 2.5 |
| declined to respond/don't know | 14.2 |

Which would be your second choice?

| | |
|------------------------------------------|------|
| schools | 7.5 |
| police | 16.7 |
| fire | 3.3 |
| health care | 9.2 |
| water/sewage | 10.0 |
| streets/roads | 7.5 |
| city government | 14.2 |
| county government | 5.0 |
| declined to respond/don't know | 26.7 |

Which one of the above services would you be willing to support with more taxes?

| | |
|------------------------------------|------|
| schools | 41.7 |
| police | 10.8 |
| fire | 2.5 |
| health care | 9.2 |
| water/sewage | 4.2 |
| streets/roads | 11.7 |
| city government | 2.5 |
| county government | 1.7 |
| declined to respond/none | 15.8 |

Which would be your second choice?

| | |
|------------------------------------|------|
| schools | 15.0 |
| police | 18.3 |
| fire | 5.8 |
| health care | 11.7 |
| water/sewage | 5.0 |
| streets/roads | 12.5 |
| city government | 7.5 |
| county government | 1.7 |
| declined to respond/none | 22.5 |

| Response Choices | | Percent Making Each Choice |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------------------------|
| Do you know about plans to enlarge the Decker Coal Mine? | | |
| no | | 15.0 |
| vaguely familiar (has heard about it) | | 47.5 |
| knows something about it | | 26.7 |
| quite familiar | | 10.8 |
| declined to respond | | 0.0 |
| Would you like to know more about these plans? | | |
| yes | | 44.2 |
| no | | 25.8 |
| neutral | | 30.0 |
| declined to respond | | 0.0 |
| If 250 new families (i.e., at least 1,000 people) move into Sheridan during the next two years, do you think that part of the increased cost of services should be paid by the industry that employs the new families? | | |
| agree | | 74.2 |
| disagree | | 15.8 |
| there will be no increased cost | | 0.0 |
| neutral | | 8.3 |
| declined to respond | | 1.7 |
| Has the arrival of Decker coal miners and related workers increased the cost of housing more than it would have increased as part of a national trend? | | |
| yes | | 69.2 |
| no | | 14.2 |
| don't know | | 16.7 |
| declined to respond | | 0.0 |
| In Sheridan the average rent for an unfurnished, one-bedroom apartment, without utilities is: | | |
| about \$100 per month | | 19.2 |
| about \$125 per month | | 30.0 |
| about \$150 per month | | 24.2 |
| about \$175 per month or over | | 10.0 |
| don't know | | 16.7 |
| declined to respond | | 0.0 |
| Are you or others you know who rent paying higher rent than two years ago for the same place? | | |
| yes, slightly higher (less than 20 percent) | | 20.8 |
| yes, much higher (20 percent or more) | | 50.0 |
| no | | 1.7 |
| don't know | | 27.5 |
| declined to respond | | 0.0 |

| Response Choices | Percent Making Each Choice |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| Property taxes in Sheridan are _____ taxes in comparable communities? | |
| higher than | 8.3 |
| the same as | 25.0 |
| lower than | 16.7 |
| don't know | 50.0 |
| declined to respond | 0.0 |
| State coal taxes and workers' income taxes at Decker Mine are payable to Montana although most of the workers live in Wyoming. Local taxes paid by the workers are property and sales taxes. What can be done about the service costs related to this situation? | |
| Nothing; moreover, local business gains and present taxes should be sufficient to pay for service to these workers; | 10.8 |
| Sheridan will have to levy a city sales tax; | 0.0 |
| The coal industry should help pay these costs; | 8.3 |
| The states of Montana and Wyoming should help pay these costs; | 15.8 |
| The coal industry and the two states should jointly help pay these costs; | 58.3 |
| declined to respond | 6.7 |
| What people or institutions are making plans and decisions about growth in Sheridan? (Select the main one.) | |
| city planning board | 29.2 |
| county planning board | 16.7 |
| state planning agency | 4.2 |
| industry | 3.3 |
| private agencies, such as Powder River Resource Council | 8.3 |
| the federal government | 20.8 |
| don't know | 17.5 |
| declined to respond | 0.0 |
| How well are they doing it? | |
| adequately | 20.8 |
| inadequately | 13.3 |
| it doesn't matter; planning is not effective | 0.0 |
| don't know | 65.0 |
| declined to respond | 0.8 |

| Response Choices | | Percent Making Each Choice |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------------------------|
| How satisfied are you with the public (i.e., your) input into these plans and decisions? | | |
| satisfied | | 35.8 |
| dissatisfied | | 20.0 |
| neutral | | 17.5 |
| don't know | | 26.6 |
| declined to respond | | 0.0 |
| How satisfied are you with Decker's input into these plans and decisions? | | |
| satisfied | | 31.7 |
| dissatisfied | | 10.8 |
| neutral | | 10.0 |
| don't know | | 47.5 |
| declined to respond | | 0.0 |
| Below are listed a number of public services available to residents of Sheridan. Would you please indicate whether you are satisfied at present with each of the following services. | | |
| grade schools | | |
| satisfied | | 71.7 |
| dissatisfied | | 11.7 |
| neutral | | 4.2 |
| don't know | | 12.5 |
| declined to respond | | 0.0 |
| high school | | |
| satisfied | | 62.5 |
| dissatisfied | | 17.5 |
| neutral | | 5.8 |
| don't know | | 14.2 |
| declined to respond | | 0.0 |
| police protection | | |
| satisfied | | 55.8 |
| dissatisfied | | 31.7 |
| neutral | | 10.8 |
| don't know | | 1.7 |
| declined to respond | | 0.0 |
| hospital services | | |
| satisfied | | 72.5 |
| dissatisfied | | 21.7 |
| neutral | | 1.7 |
| don't know | | 4.2 |
| declined to respond | | 0.0 |

| Response Choices | | Percent Making Each Choice |
|-------------------------------|--|----------------------------------|
| ambulance service | | |
| satisfied | | 73.3 |
| dissatisfied | | 6.7 |
| neutral | | 7.5 |
| don't know | | 12.5 |
| declined to respond | | 0.0 |
| sewage service | | |
| satisfied | | 74.2 |
| dissatisfied | | 15.8 |
| neutral | | 5.0 |
| don't know | | 5.0 |
| declined to respond | | 0.0 |
| water supply system | | |
| satisfied | | 79.2 |
| dissatisfied | | 13.3 |
| neutral | | 4.2 |
| don't know | | 3.3 |
| declined to respond | | 0.0 |
| shopping facilities | | |
| satisfied | | 66.7 |
| dissatisfied | | 26.7 |
| neutral | | 6.7 |
| don't know | | 0.0 |
| declined to respond | | 0.0 |
| streets and roads | | |
| satisfied | | 50.0 |
| dissatisfied | | 34.2 |
| neutral | | 15.0 |
| don't know | | 0.8 |
| declined to respond | | 0.0 |
| fire protection | | |
| satisfied | | 84.2 |
| dissatisfied | | 8.3 |
| neutral | | 1.7 |
| don't know | | 5.8 |
| declined to respond | | 0.0 |
| city government | | |
| satisfied | | 41.7 |
| dissatisfied | | 34.2 |
| neutral | | 12.5 |
| don't know | | 11.7 |
| declined to respond | | 0.0 |

| Response Choices | Percent Making Each Choice |
|-------------------------------|----------------------------------|
| county government | |
| satisfied | 55.0 |
| dissatisfied | 15.0 |
| neutral | 15.0 |
| don't know | 15.0 |
| declined to respond | 0.0 |
| mental health services | |
| satisfied | 73.3 |
| dissatisfied | 6.7 |
| neutral | 5.0 |
| don't know | 15.0 |
| declined to respond | 0.0 |
| recreation facilities | |
| satisfied | 74.2 |
| dissatisfied | 19.2 |
| neutral | 5.0 |
| don't know | 1.7 |
| declined to respond | 0.0 |
| service to senior citizens | |
| satisfied | 80.8 |
| dissatisfied | 6.7 |
| neutral | 5.8 |
| don't know | 6.7 |
| declined to respond | 0.0 |
| dental services | |
| satisfied | 87.5 |
| dissatisfied | 4.2 |
| neutral | 3.3 |
| don't know | 5.0 |
| declined to respond | 0.0 |
| medical services | |
| satisfied | 80.0 |
| dissatisfied | 10.0 |
| neutral | 5.8 |
| don't know | 4.2 |
| declined to respond | 0.0 |

If 250 new families (at least 1,000 people) move into Sheridan during the next two years, and assuming that Sheridan's city and county finances will be about what they are now, how would each of the following services be affected? It would be:

Response Choices

Percent
Making
Each Choice

| | |
|-------------------------------------------|------|
| grade schools | |
| increased and/or improved | 2.5 |
| decreased and/or detrimental to | 72.5 |
| unaffected | 8.3 |
| don't know | 15.0 |
| declined to respond | 1.7 |
| high school | |
| increased and/or improved | 4.2 |
| decreased and/or detrimental to | 65.0 |
| unaffected | 12.5 |
| don't know | 15.8 |
| declined to respond | 2.5 |
| police protection | |
| increased and/or improved | 5.8 |
| decreased and/or detrimental to | 75.8 |
| unaffected | 10.0 |
| don't know | 6.7 |
| declined to respond | 1.7 |
| hospital services | |
| increased and/or improved | 7.5 |
| decreased and/or detrimental to | 60.8 |
| unaffected | 17.5 |
| don't know | 11.7 |
| declined to respond | 2.5 |
| ambulance service | |
| increased and/or improved | 10.8 |
| decreased and/or detrimental to | 43.3 |
| unaffected | 29.2 |
| don't know | 14.2 |
| declined to respond | 2.5 |
| sewage service | |
| increased and/or improved | 5.8 |
| decreased and/or detrimental to | 61.7 |
| unaffected | 11.7 |
| don't know | 18.3 |
| declined to respond | 2.5 |
| water supply system | |
| increased and/or improved | 8.3 |
| decreased and/or detrimental to | 59.2 |
| unaffected | 14.2 |
| don't know | 15.8 |
| declined to respond | 2.5 |

Response Choices

Percent
Making
Each Choice

| | | |
|-------------------------------------------|--|------|
| shopping facilities | | |
| increased and/or improved | | 20.0 |
| decreased and/or detrimental to | | 47.5 |
| unaffected | | 22.5 |
| don't know | | 7.5 |
| declined to respond | | 2.5 |
| streets and roads | | |
| increased and/or improved | | 10.8 |
| decreased and/or detrimental to | | 57.5 |
| unaffected | | 17.5 |
| don't know | | 11.7 |
| declined to respond | | 2.5 |
| fire protection | | |
| increased and/or improved | | 10.8 |
| decreased and/or detrimental to | | 55.8 |
| unaffected | | 19.2 |
| don't know | | 11.7 |
| declined to respond | | 2.5 |
| city government | | |
| increased and/or improved | | 10.0 |
| decreased and/or detrimental to | | 41.7 |
| unaffected | | 25.0 |
| don't know | | 20.8 |
| declined to respond | | 2.5 |
| county government | | |
| increased and/or improved | | 10.0 |
| decreased and/or detrimental to | | 34.2 |
| unaffected | | 28.3 |
| don't know | | 25.0 |
| declined to respond | | 2.5 |
| mental health services | | |
| increased and/or improved | | 10.0 |
| decreased and/or detrimental to | | 36.7 |
| unaffected | | 29.2 |
| don't know | | 21.7 |
| declined to respond | | 2.5 |
| recreation facilities | | |
| increased and/or improved | | 9.2 |
| decreased and/or detrimental to | | 55.0 |
| unaffected | | 20.0 |
| don't know | | 13.3 |
| declined to respond | | 2.5 |

Response Choices

Percent
Making
Each Choice

service to senior citizens

| | |
|-------------------------------------------|------|
| increased and/or improved | 12.5 |
| decreased and/or detrimental to | 23.3 |
| unaffected | 47.5 |
| don't know | 14.2 |
| declined to respond | 2.5 |

dental services

| | |
|-------------------------------------------|------|
| increased and/or improved | 11.7 |
| decreased and/or detrimental to | 40.8 |
| unaffected | 32.5 |
| don't know | 12.5 |
| declined to respond | 2.5 |

medical services

| | |
|-------------------------------------------|------|
| increased and/or improved | 10.8 |
| decreased and/or detrimental to | 47.5 |
| unaffected | 27.5 |
| don't know | 11.7 |
| declined to respond | 2.5 |

If 250 new families (at least 1,000 people) move into Sheridan, what effect would that have on the following aspects of your life?

better and/or more secure job opportunities

| | |
|-----------------------------------------|------|
| increase or improve | 25.8 |
| decrease or be detrimental to | 19.2 |
| no effect | 51.7 |
| don't know | 2.5 |
| declined to respond | 0.8 |

recreational opportunities

| | |
|-----------------------------------------|------|
| increase or improve | 5.0 |
| decrease or be detrimental to | 40.8 |
| no effect | 49.2 |
| don't know | 3.3 |
| declined to respond | 1.7 |

enjoyment of life in general

| | |
|-----------------------------------------|------|
| increase or improve | 5.8 |
| decrease or be detrimental to | 30.0 |
| no effect | 61.7 |
| don't know | 1.7 |
| declined to respond | 0.8 |

| Response Choices | Percent Making Each Choice |
|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| feelings toward Sheridan | |
| increase or improve | 6.7 |
| decrease or be detrimental to | 16.7 |
| no effect | 73.3 |
| don't know | 2.5 |
| declined to respond | 0.8 |
| feeling being a part of the community of Sheridan | |
| increase or improve | 7.5 |
| decrease or be detrimental to | 14.2 |
| no effect | 74.2 |
| don't know | 3.3 |
| declined to respond | 0.8 |
| feelings of safety | |
| increase or improve | 1.7 |
| decrease or be detrimental to | 56.7 |
| no effect | 36.7 |
| don't know | 4.2 |
| declined to respond | 0.8 |
| If 250 families (at least 1,000 people) move into Sheridan, would you agree, disagree, or be neutral toward the following statements? | |
| There would be more jobs in Sheridan. | |
| agree | 54.2 |
| disagree | 38.3 |
| neutral | 4.2 |
| don't know | 3.3 |
| declined to respond | 0.0 |
| All of us would have to pay more taxes for schools. | |
| agree | 79.2 |
| disagree | 12.5 |
| neutral | 3.3 |
| don't know | 5.0 |
| declined to respond | 0.0 |
| Local people would still control decisions. | |
| agree | 59.2 |
| disagree | 22.5 |
| neutral | 3.3 |
| don't know | 15.0 |
| declined to respond | 0.0 |

Response Choices

Percent
Making
Each Choice

Sheridan would be a better place to live.

| | |
|-------------------------------|------|
| agree | 11.7 |
| disagree | 45.0 |
| neutral | 32.5 |
| don't know | 10.8 |
| declined to respond | 0.0 |

The newcomers would be easily accepted into the community.

| | |
|-------------------------------|------|
| agree | 49.2 |
| disagree | 25.0 |
| neutral | 11.7 |
| don't know | 14.2 |
| declined to respond | 0.0 |

The price of housing would go up sharply.

| | |
|-------------------------------|------|
| agree | 80.8 |
| disagree | 12.5 |
| neutral | 2.5 |
| don't know | 4.2 |
| declined to respond | 0.0 |

Sheridan could handle that many more people.

| | |
|-------------------------------|------|
| agree | 36.7 |
| disagree | 40.8 |
| neutral | 8.3 |
| don't know | 14.2 |
| declined to respond | 0.0 |

We are interested in learning about social change in Sheridan. Which one of the following items has changed most in the past three years?

| | |
|------------------------------------------------------|------|
| housing costs | 55.0 |
| other living costs | 26.7 |
| employment opportunities | 6.7 |
| recreational opportunities | 0.8 |
| community services (e.g., schools, police) | 0.0 |
| relationships between groups of people | 1.7 |
| health-related services | 0.8 |
| don't know | 7.5 |
| declined to respond | 0.8 |

Has this change been for the better or worse?

| | |
|------------------------------------|------|
| better | 7.5 |
| worse | 80.0 |
| neither better nor worse | 3.3 |
| don't know | 7.5 |
| declined to respond | 1.7 |

| Response Choices | Percent Making Each Choice |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| If 250 families (at least 1,000 people) move into Sheridan in the next two years, which of the following items would be most affected (select one)? | |
| housing costs | 21.7 |
| other living costs | 8.3 |
| employment opportunities | 6.7 |
| recreational opportunities | 0.8 |
| community services (e.g., schools, police) | 10.0 |
| relationships between groups of people | 2.5 |
| housing availability | 47.5 |
| health-related services | 0.0 |
| declined to respond | 2.5 |
| Would it be affected for the better or worse? | |
| better | 3.3 |
| worse | 91.7 |
| neither better nor worse | 0.0 |
| don't know | 2.5 |
| declined to respond | 2.5 |
| Have the workers from the present Decker Mine had any effect on Sheridan? | |
| yes--I am aware of them | 57.5 |
| no--I haven't noticed them | 31.7 |
| don't know | 10.8 |
| declined to respond | 0.0 |
| What has been the principal effect of the Decker Coal Company on Sheridan (select one)? | |
| no impact | 0.8 |
| economically beneficial | 34.2 |
| economically beneficial but socially detrimental | 5.8 |
| increased rents and living costs | 36.7 |
| crowded service and recreational facilities | 4.2 |
| addition of more educated and interesting people | 1.7 |
| improvement in the general housing situation, e.g., construction of new housing and remodeling of old | 2.5 |
| don't know | 12.5 |
| declined to respond | 1.7 |

| Response Choices | Percent Making Each Choice |
|---------------------------------------------------------------------------------------------|----------------------------------|
| Everything considered, I believe that approval should be granted to expand the Decker Mine. | |
| yes | 51.7 |
| no | 6.7 |
| neutral | 1.7 |
| I need to know more about the expansion plans and the likely consequences | 35.0 |
| don't know | 5.0 |
| declined to respond | 0.0 |

FINANCIAL PLANNING AND DEVELOPMENT SCHEDULE

FOR SHERIDAN AREA PLANNING AGENCY

FOR FISCAL YEARS 1976 AND 1977

FINANCIAL PLANNING AND DEVELOPMENT SCHEDULE

ANALYSIS STATEMENT

For Fiscal Years 1976 and 1977 up to the present date of March 4, 1977, Sheridan Area Planning Agency has prepared or offered technical assistance and endorsement on the following projects.

| | | |
|--------------------------------------|---|--------------------|
| Total Number of Projects Approved | = | 34 |
| Total Number of Projects Denied | = | 3 |
| Total Number of Projects Pending | = | 5 |
| Total Number of Projects Applied for | = | 42 |
| Total Amount of Dollars Applied for | = | \$ 5,597,228** |
| 81% Approved | = | 34 = \$1,502,348 |
| 7% Denied | = | 3 = 400,000 |
| 12% Pending | = | 5 = 3,351,100 |
| | | <u>\$5,253,448</u> |

Total Number of Grants Applied for Planning Purposes Only

| <u>Number Applied For</u> | <u>Number Approved</u> | <u>Amount Approved</u> | <u>Average Amount Approved Per Grant</u> |
|---------------------------|------------------------|------------------------|------------------------------------------|
| 25 | 25 | \$214,128 | \$8,565 |

The Grants mentioned above come from Federal, State and local sources.

**Please note the total amount of dollars applied for may not equal the total amount of dollars approved, denied and pending. The reason for this is that some grants have only a portion approved or funded. Therefore, the amount approved may be less than the amount applied for.

FINANCIAL PLANNING
AND
DEVELOPMENT SCHEDULE

| Project | Cost | Community or County-Wide | Funding Source | A P P L I C A T I O N S | | | | Type of Funding |
|-----------------------------|-----------|--------------------------------|--------------------|-------------------------|---------|-----------|--------|-----------------------|
| | | | | Made | Pending | Approved | Denied | |
| 1. COUNTY ROADS | \$605,000 | COUNTY-WIDE | FARM-LOAN BOARD | ✓ | | \$605,000 | | 100% |
| 2. PARK | \$62,000 | DAYTON | B.O.R. | ✓ | | 31,000 | | 50% |
| 3. C.D. GRANT (SEWER) | 100,000 | RANCHESTER | HUD-C.D.B.C. | ✓ | | 30,000 | | 100% |
| SEWER & WATER | | SHERIDAN | HUD-C.D.B.C. | | | 60,000 | | 100% |
| ADMINIS- TRATION | | SHERIDAN & RANCHESTER | HUD-C.D.B.C. | | | 10,000 | | 100% |
| 4. WATER | 60,000 | CLEARMONT | HUD-C.D.B.C. | ✓ | | | ✓ | 100% |

FINANCIAL PLANNING
AND
DEVELOPMENT SCHEDULE

| Project | Cost | Community or County-Wide | Funding Source | A P P L I C A T I O N S | | | | Type of Funding |
|--------------------------------|----------|--------------------------------|--------------------------------------------|-------------------------|---------|----------|--------|-----------------------|
| | | | | Made | Pending | Approved | Denied | |
| | | | | | | | | |
| 5. WATER | \$40,000 | DAYTON | H.U.D.-C.D.B.C. | ✓ | | | ✓ | 100 % |
| 6. FY 76 701 PLANNING | 20,850 | COUNTY-WIDE | H.U.D. | ✓ | | 13,900 | | 2/3 MATCH |
| 7. FY 77 701 PLANNING | 11,489 | COUNTY-WIDE | H.U.D. | ✓ | | 7,659 | | 2/3 MATCH |
| 8. PLANNING | 30,000 | COUNTY-WIDE | (1.) OLD WEST REGIONAL COMMISSION | ✓ | | 30,000 | | 100 % |
| 9. FISCAL MANAGEMENT | 25,000 | COUNTY-WIDE | (2.) OLD WEST REGIONAL COMMISSION | ✓ | | 25,000 | | 100 % |
| 10. FY 76 PLANNING | 13,000 | COUNTY-WIDE | SHELL OIL COMPANY | ✓ | | 13,000 | | 100 % |

FINANCIAL PLANNING
AND
DEVELOPMENT SCHEDULE

| Project | Cost | Community or County-Wide | Funding Source | A P P L I C A T I O N S | | | | Type of Funding |
|-----------------------------------------------------|----------|--------------------------------|----------------------------------------------|-------------------------|---------|----------|--------|-----------------------|
| | | | | Made | Pending | Approved | Denied | |
| | | | | | | | | |
| 11. FY 77 PLANNING | \$15,000 | COUNTY-WIDE | SHELL OIL COMPANY | ✓ | | \$15,000 | | 100% |
| 12. FY 76 PLANNING | 5,000 | COUNTY-WIDE | DECKER COAL COMPANY | ✓ | | 5,000 | | 100% |
| 13. PARKS, RECREATION & OPEN SPACE PLAN | 8,000 | COUNTY-WIDE | B.O.R. | ✓ | | 4,000 | | 50% |
| PARKS, RECREATION & OPEN SPACE PLAN | | COUNTY-WIDE | Y.M.C.A. | | | 10,000 | | 50% |
| PARKS, RECREATION & OPEN SPACE PLAN | | COUNTY-WIDE | CITY-COUNTY PARKS & REC- REATION BOARD | | | 1,500 | | 50% |
| PARKS, RECREATION & OPEN SPACE PLAN | | COUNTY-WIDE | | | | 1,500 | | 50% |

FINANCIAL PLANNING
AND
DEVELOPMENT SCHEDULE

| Project | Cost | Community or County-Wide | Funding Source | A P P L I C A T I O N S | | | Type of Funding |
|---------------------------------------------|----------|--------------------------------|---------------------|-------------------------|---------|----------|-----------------------|
| | | | | Made | Pending | Approved | Denied |
| ^{14.} FY 76 LAND-USE PLAN | \$20,000 | COUNTY-WIDE | STATE OF WYOMING | ✓ | | \$10,000 | 50% |
| FY 76 208 LAND USE PLAN | | COUNTY-WIDE | STATE OF WYOMING | | | 10,000 | 50% |
| ^{15.} FY 77 LAND-USE PLAN | 20,000 | COUNTY-WIDE | STATE OF WYOMING | ✓ | | 10,000 | 50% |
| FY 77 LAND USE PLAN | | COUNTY-WIDE | STATE OF WYOMING | | | 10,000 | 50% |
| ^{16.} FY 76 PLANNING | 2,403 | COUNTY-WIDE | W.I.C.H.E. | ✓ | | 2,403 | 100% |
| ^{17.} FY 76 PLANNING | 8,954 | COUNTY-WIDE | C.E.T.A. | ✓ | | 8,954 | 100% |

FINANCIAL PLANNING
AND
DEVELOPMENT SCHEDULE

| Project | Cost | Community or County-Wide | Funding Source | A P P L I C A T I O N S | | | | Type of Funding |
|--------------------------|-------------|--------------------------------|-------------------|-------------------------|---------|----------|--------|-----------------------|
| | | | | Made | Pending | Approved | Denied | |
| | | | | | | | | |
| 18. FY 77 PLANNING | \$24,000 | COUNTY-WIDE | C.E.T.A. | ✓ | | \$24,000 | | 100% |
| 19. FY 77 PLANNING | 2,632 | COUNTY-WIDE | W.I.C.H.E. | ✓ | | 2,632 | | 100% |
| 20. WATER | 2.7 MILLION | SHERIDAN | E.D.A. | ✓ | ✓ | | | 100% |
| 21. WATER | 220,000 | CLEARMONT | E.D.A. | ✓ | ✓ | | | 100% |
| 22. TOWN HALL | 224,000 | RANCHESTER | E.D.A. | ✓ | ✓ | | | 100% |
| 23. WATER | 120,000 | DAYTON | E.D.A. | ✓ | ✓ | | | 100% |

FINANCIAL PLANNING

AND

DEVELOPMENT SCHEDULE

| Project | Cost | Community or County-Wide | Funding Source | A P P L I C A T I O N S | | | | Type of Funding |
|--------------------------|-------|--------------------------------|-------------------|-------------------------|---------|----------|--------|-----------------------|
| | | | | Made | Pending | Approved | Denied | |
| | | | | | | | | |
| 41. FY 76 PLANNING | \$200 | COUNTY-WIDE | RANCHESTER | ✓ | | \$200 | | 100% |
| 42. FY 77 PLANNING | 200 | COUNTY-WIDE | RANCHESTER | ✓ | | 200 | | 100% |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

FINANCIAL PLANNING
AND
DEVELOPMENT SCHEDULE

| Project | Cost | Community or County-Wide | Funding Source | A P P L I C A T I O N S | | | | Type of Funding |
|-------------------------------------------------------|---------|--------------------------------|----------------------------------------|-------------------------|---------|----------|--------|-----------------------|
| | | | | Made | Pending | Approved | Denied | |
| | | | | | | | | |
| 24. GOOSE CREEK PRODUCTS PLANNING | \$4,000 | COUNTY-WIDE | G.C.P. | ✓ | | \$4,000 | | 100% |
| 25. G.C.P. HANDICAP HOUSING REHAB. | 50,000 | COUNTY-WIDE | SECTION 8 RENT SUBSIDY H.U.D. | ✓ | | 50,000 | | 100% |
| 26 HOUSING REHAB. PARKS & DAY CARE CENTER | 300,000 | SHERIDAN | H.U.D. | ✓ | | 150,000 | | 100% |
| 27 CENTER FOR HANDICAP HOUSING REHAB. | 300,000 | COUNTY-WIDE | H.U.D. | ✓ | | 270,000 | | 100% |
| 28 HOUSING RE- HAB, IMPROVE WATER SYSTEM | 300,000 | CLEARMONT | H.U.D. | ✓ | | | ✓ | 100% |

FINANCIAL PLANNING
AND
DEVELOPMENT SCHEDULE

| Project | Cost | Community or County-Wide | Funding Source | A P P L I C A T I O N S | | | Type of Funding |
|---------------------------------------------|----------|--------------------------------|--------------------|-------------------------|---------|----------|-----------------------|
| | | | | Made | Pending | Approved | Denied |
| 29. ENGINEER- ING | \$50,000 | RANCHESTER | FARM-LOAN BOARD | | | \$25,000 | 100% |
| 30. COUNTY FAIR GROUNDS HORSE BARN | 10,000 | COUNTY-WIDE | B.O.R. | ✓ | ✓ | | 100% |
| 31. ENGINEER- ING | 27,000 | CLEARMONT | FARM LOAN BOARD | ✓ | | 27,000 | 100% |
| 32. ENGINEER- ING | 123,000 | SHERIDAN | FARM-LOAN BOARD | ✓ | | 30,000 | 100% |
| 33. FY 76 PLANNING | 4,500 | COUNTY-WIDE | COUNTY | ✓ | | 4,500 | 100% |
| 34. FY 77 PLANNING | 4,500 | COUNTY-WIDE | COUNTY | ✓ | | 4,500 | 100% |

FINANCIAL PLANNING

AND

DEVELOPMENT SCHEDULE

| Project | Cost | Community or County-Wide | Funding Source | A P P L I C A T I O N S | | | | Type of Funding |
|--------------------------|---------|--------------------------------|-------------------|-------------------------|---------|----------|--------|-----------------------|
| | | | | Made | Pending | Approved | Denied | |
| | | | | | | | | |
| 35. FY 76 PLANNING | \$4,500 | COUNTY-WIDE | SHERIDAN | ✓ | | \$4,500 | | 100% |
| 36. FY 77 PLANNING | 4,500 | COUNTY-WIDE | COUNTY | ✓ | | 4,500 | | 100% |
| 37. FY 76 PLANNING | 100 | COUNTY-WIDE | CLEARMONT | ✓ | | 100 | | 100% |
| 38. FY 77 PLANNING | 100 | COUNTY-WIDE | CLEARMONT | ✓ | | 100 | | 100% |
| 39. FY 76 PLANNING | 100 | COUNTY-WIDE | DAYTON | ✓ | | 100 | | 100% |
| 40. FY 77 PLANNING | 100 | COUNTY-WIDE | DAYTON | ✓ | | 100 | | 100% |

APPENDIX H

ARCHAEOLOGY

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FOR

ARCHAEOLOGY

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| 1975 Final Archaeological Report of the East Decker and North Extension areas | H-2 |
| Field survey techniques for the 1976 archaeological survey reconnaissance in the proposed mine areas | H-37 |

MINERAL RESEARCH CENTER

Post Office Box 3708 • (406) 494-2778 • Butte, Montana 59701

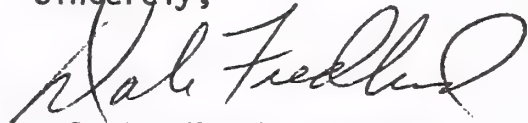
February 2, 1977

Dear Brace:

Enclosed is the original copy of the Decker report with minor corrections and the new figures. We did not number the figure pages. Also note that pages 22 and 23 have been reversed.

Please return as soon as possible as this is our only copy.

Sincerely,



Dale Fredlund, Research
Archaeologist

DF:ht

The 1975 Archaeological Survey
and Testing of
Decker Coal Company Lands
Big Horn County, Montana
Final Report

by

Lynn Berry Fredlund

Mineral Research Center

of

The Montana College of
Mineral Science and Technology
Foundation

P. O. Box 3708
Butte, Montana 59701

ACKNOWLEDGEMENTS

There were some cold, miserable, rainy days when this survey began but the crew members worked hard in spite of the weather. We would like to thank all of our personnel: Bob Lanktree, Elaine Howard, Roger Tro, and K-T Gazunis. Fidel Masao and Jill Thompson spent many extra hours mapping, collecting, revisiting, and reevaluating the sites with me. Paul Anderson tried hard to get dramatic photographs of the surveyed area and the sites. Kathy Tro kept the morale of all high by keeping everyone well-fed in camp.

To all of these persons, a big thank you. Also to Helen Harrington, who typed this manuscript and its many changes.

Lynn Fredlund

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INTRODUCTION

On February 26, 1975, the Mineral Research Center of the Montana College of Mineral Science and Technology Foundation, Butte, Montana, entered into an agreement with the Decker Coal Company, Sheridan, Wyoming to conduct an intensive archaeological survey on the following lands in Big Horn County, Montana:

| | | | | |
|---------------------|----|------|----|------|
| T9S R40E Sections - | 1 | All | 12 | All |
| | 3 | Part | 13 | All |
| | 4 | Part | 14 | Part |
| | 9 | Part | 23 | Part |
| | 10 | Part | 24 | Part |
| | 11 | Part | | |

| | | |
|---------------------|----|------|
| T8S R40E Sections - | 33 | Part |
| | 34 | Part |
| | 35 | Part |

| | | |
|---------------------|----|------|
| T9S R41E Sections - | 5 | All |
| | 6 | All |
| | 7 | All |
| | 8 | All |
| | 17 | Part |
| | 18 | Part |

All partial sections included in the survey area are shown in Fig. 1. Federally owned lands were surveyed under Antiquity Permit number 75-MT-099. Fieldwork (federal lands exempted) was completed in 112 man-days and a preliminary report was presented to the Decker Coal Company on June 31, 1975. The federal lands and preliminary report on these lands was completed by November, 1975. This report presents the final results of the archaeological survey based on laboratory research and literature review for all federal and private lands surveyed.

GEOMORPHOLOGY

This study area consists of two separate land units separated by the Tongue River Reservoir, Big Horn County, in southcentral Montana. The area east of the reservoir is known as the East Decker unit and the area west of the reservoir as the West Decker unit. The topography (Fig. 3) of both units is predominantly rolling grasslands and low ridges separated by intermittent streams. Deer Creek and Coal Creek flow across the East Decker unit to enter the Tongue River Reservoir. The West Decker unit is drained by Pearson Creek and Spring Creek. Terrace sediments along the drainages are composed of Kaycee Formation Alluvial deposits

Figure 1.--Location of archaeological sites within the
boundaries of the surveyed area.

(see p. 299, Volume I)

with exposures of Tongue River sandstone and shale along the ridges. Occasional outcrops of baked shale, non-volcanic natural glass, porcelainite, and clinker (originating from ancient coal burns), occur in the higher north area of the East Decker unit and on some of the ridges in the West Decker unit.

ECOLOGICAL ZONES

Several broad, ecologic-topographic zones occur in the survey area. The principle zones can be characterized as rolling open grass and sage lands, and a stream-side zone along the creeks and dry washes that supports scattered cottonwood and box elder trees. The third general unit consists of the ridges and bench-lands which support sagebrush, juniper, occasional ponderosa pine, and various short grass species. The archaeological sites are predominantly located within the ridges and juniper breaks.

METHODS AND TECHNIQUES

The entire survey area was covered systematically by trained persons walking designated areas each day. Initially, each site located was recorded on a site survey form which is on file at the Mineral Research Center, Montana College of Mineral Science and Technology Foundation, Butte, Montana. Further information on each site and the area covered by each individual surveyor is included in the daily field notes which are also on file at the Mineral Research Center in Butte. Daily records of the area covered by each surveyor were recorded on USGS maps in order to insure complete coverage of the survey area.

Subsequent to the initial site recording, each site was revisited by the Principal Investigator (Lynn Fredlund) who supervised the testing, mapping and collection of the site. Techniques of testing, mapping, and collecting were based on the quantities, extent and type of features and/or cultural materials observed on the site surface. When warranted, 10 cm diameter holes were drilled to a depth of three feet with a power auger to test for subsurface deposits. Power-augering was used as a subsurface evaluative technique in all areas of archaeological site potential.

RESULTS

A description of each located site is presented below, including comment on the activity associated with the site (e.g., "look out", "occupation", etc.). Interpretation of site function is based primarily

on the topographic setting and analysis of the tools recovered. Names as well as numbers are given to each site. The site names, which were given by the individual who located the site, are basically used as mnemonic devices.

24BH1510 Three Deer Tipi Rings Site

Location: West Decker; T9S, R40E, NE¼ of SE¼ of Section 4

Elevation: 3520 feet

Type: Occupation

Five stone rings were found on the ridge forming the north side of Pearson Creek. Two rings are located on the highest terrace and the other three on lobes of the lower terrace (Fig. 2). One of the five rings was very fragmentary and two others were partially disturbed by erosion. Four had evidence of a hearth but no charcoal or depth was associated (Table 1). The site was mapped (Fig. 2) and all cultural debris was collected. Photos were taken of the site area and data on each stone ring recorded.

TABLE 1 -- Description of stone rings at 24BH1510

| Ring number | Number of Stones | Stone Courses | Diameter | Entrance | Hearthrock |
|--------------|------------------|---------------|----------|----------|------------|
| 1-incomplete | 71 | 2 | 5.0 m | none | 4 |
| 2 | 57 | 1 | 4.0 m | none | 3 |
| 3-incomplete | 19 | unk. | 3.5 m | none | none |
| 4 | 26 | 1 | 3.0 m | none | 3 |
| 5-incomplete | 10 | 1 | 4.0 m | none | 4 |

The vegetation at the Three Deer Tipi Rings Site is consistent with the surrounding grassland: range grasses, scattered Rhus tribolata, cactus, and several species of sage are all present on the surface.

Two fragments of bifacially worked stone tools were recovered. One is a large bifacially flaked preform of basalt (Fig. 5a), the other an end fragment of a bifacially flaked cutting tool of quartzite. This quartzite tool exhibits wear on one cutting edge.

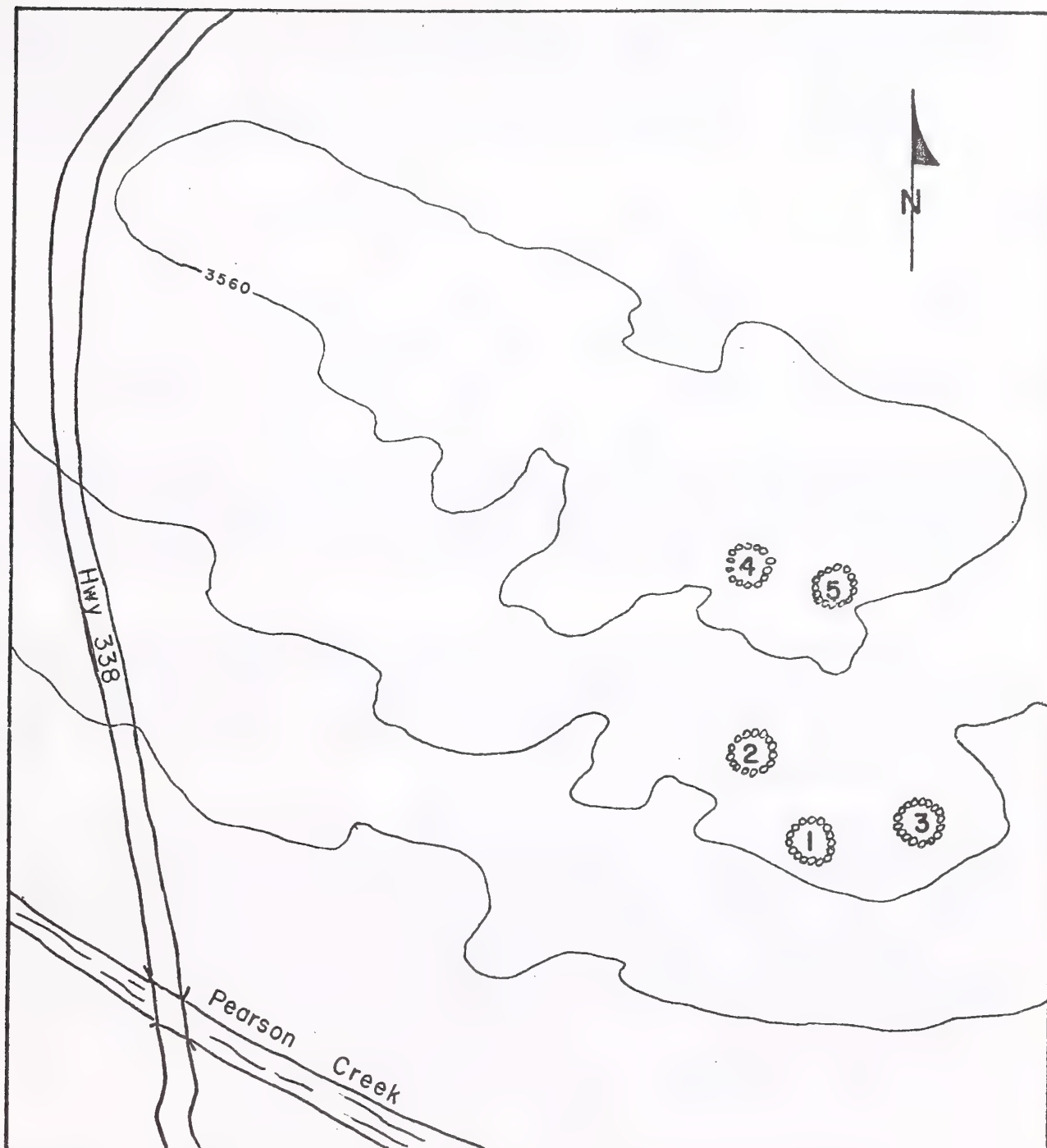


Figure 2.--Stone rings at the Three Deer Ring Site 24BH1510 (sketch map, not to scale).

Recommendations: 24BH1510 has been photographed, sketch-mapped, collected and recorded. Instrument mapping was not done at this site due to the wide scatter and altitudinal variation of the rings. No evidence of unusual or significant features that might warrant any additional fieldwork was noted. It is doubtful if further research would be productive.

24BH1511 All Gone Site

Location: West Decker; T8S, R40E, NW¼ of NW¼ of Section 34

Elevation: 3500 feet

Type: Hide Preparation Activity

Three scrapers, three bifacially flaked tools, one bifacially flaked preform, and one large (13 cm long), well-made, bifacially flaked, grey porcellanite knife or spear point were recovered and their locations plotted (Fig. 6). Only four flakes of detritus were noted, which suggests that little sharpening or fabrication of tools was carried out at the site.

All cultural material was located on a red clay bench just to the west of the road to the Tongue River Reservoir. The site surface was deflated, and the floor of the site is comprised of red sandstone and shale. Vegetation on the site is very sparse with only a few clumps of grasses, sage, and junipers evident.

Of the three end scrapers recovered, one is keel backed and made of a purple chert (Fig. 5b), and two are flat backed scrapers (Fig. 5 c, d). One is made of grey porcellanite and the other is of a white chert. One large, lanceolate shaped biface (Fig. 5e) of grey porcellanite may have had multiple functions of cutting and scraping. Steep-angle (60°) re-touch forms a scraper edge on the shallow convex blade edge, whereas the opposing edge exhibits a normal bifacial chipping. Two end fragments of a biface also made of grey porcellanite were recovered. Metric data for the scrapers and bifaces is presented in Table 2.

Table 2 -- Metric data on 3 scrapers and 3 bifaces from the All Gone Site

| Artifact Measures (in cm) | | | | | |
|---------------------------|---------------|--------------|------------------|------------------------|-----------------------------------------|
| <u>Tool Type</u> | <u>Length</u> | <u>Width</u> | <u>Thickness</u> | <u>Material</u> | <u>Comments</u> |
| Flat Back End Scraper | 4.8 | 3.3 | 1.0 | grey por- cellanite | complete striking plat- form present |

| | | | | | |
|--------------------------|-----|-----|-----|------------------------|--------------------------|
| Flat Back End Scraper | 2.2 | 2.4 | .5 | white chert | distal end fragment |
| Keel Back End Scraper | 2.6 | 2.5 | .9 | red chert | complete |
| Biface | 13 | 4.3 | 1.2 | grey por- cellanite | multi-functional tool |
| Biface | 3.1 | 4.2 | 1.0 | grey por- cellanite | end fragment |
| Biface preform | 5.1 | 2.9 | 1.1 | red por- cellanite | crude workmanship |

Recommendations: The site area was photographed, and a total pick-up and sketch map made. No further work is recommended at the site.

24BH1512 Fat Albert Site

Location: West Decker; T8S, R40E, SE $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 33

Elevation: 3520 feet

Type: Lookout

Located on two small knolls on the ridges west of the main highway, this site, because of its wide scatter of material and location is probably a lookout site. The scatter of artifacts covers an area of about 100 meters along the ridge and 20 meters back from the edge. Within this area there are several concentrations of porcellanite flakes. No tools of any kind were found. The vegetation is typical of the ridges and knolls in the area and consists of sagebrush, cheat grass and various other range grasses.

Recommendations: Photographs were taken, a sketch map made and a pickup conducted at the site. Additional research is not warranted.

24BH1513 Puppy Site

Location: West Decker; T8S, R40E, SE $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 33

Elevation: 3505 feet

Type: Lookout

Not far from 24BH1512, is this grass and sage covered knoll which has flakes of porcellanite extending down from the highest point. The flakes are sparsely scattered over an area of about 3600 square meters. No tools were noted.

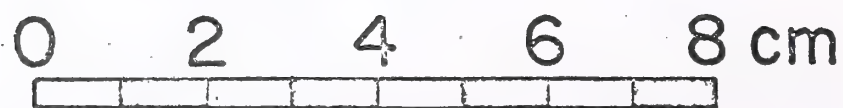
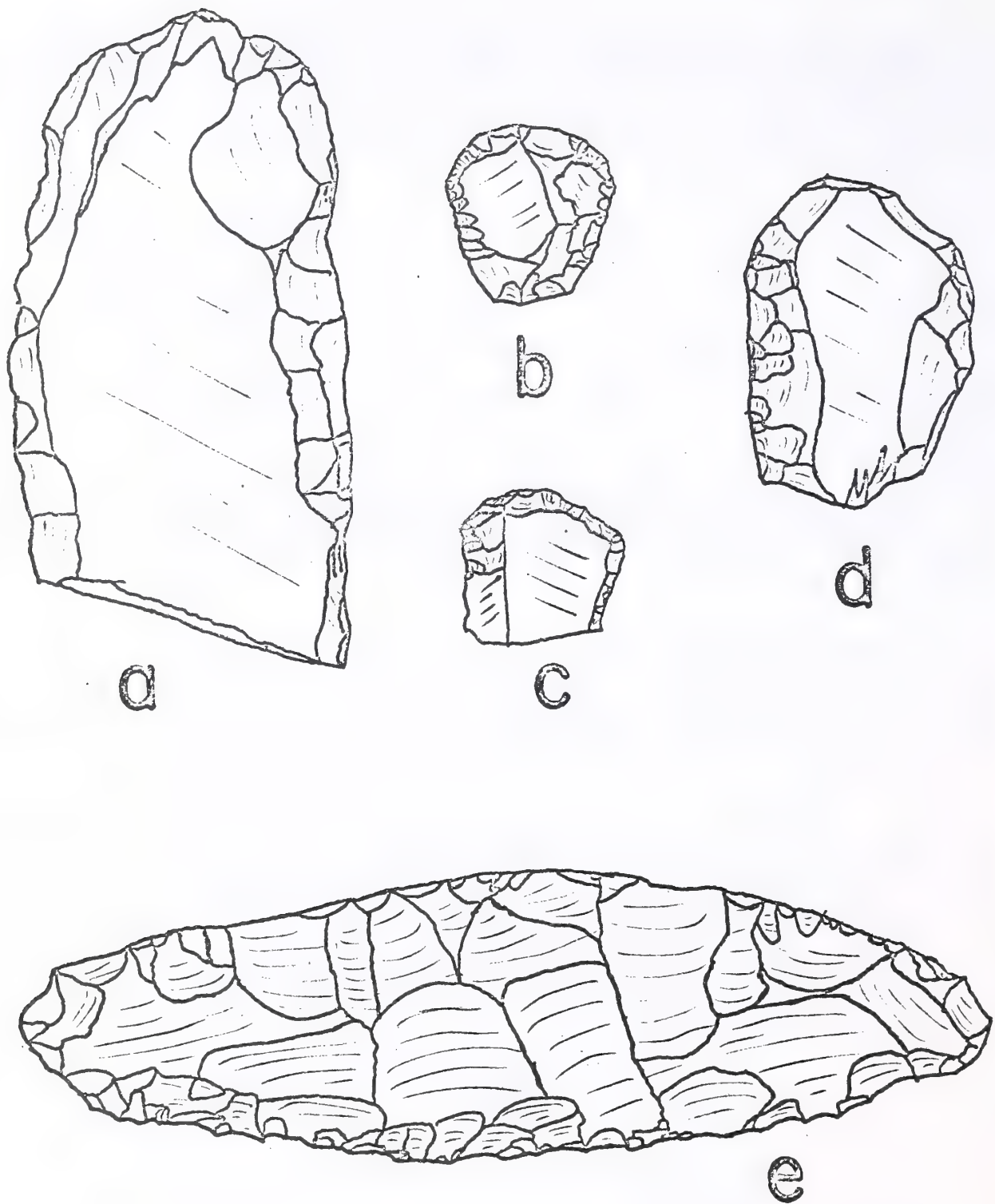


Figure 5 Select stone tools from 24BH1510 and 24BH1511.

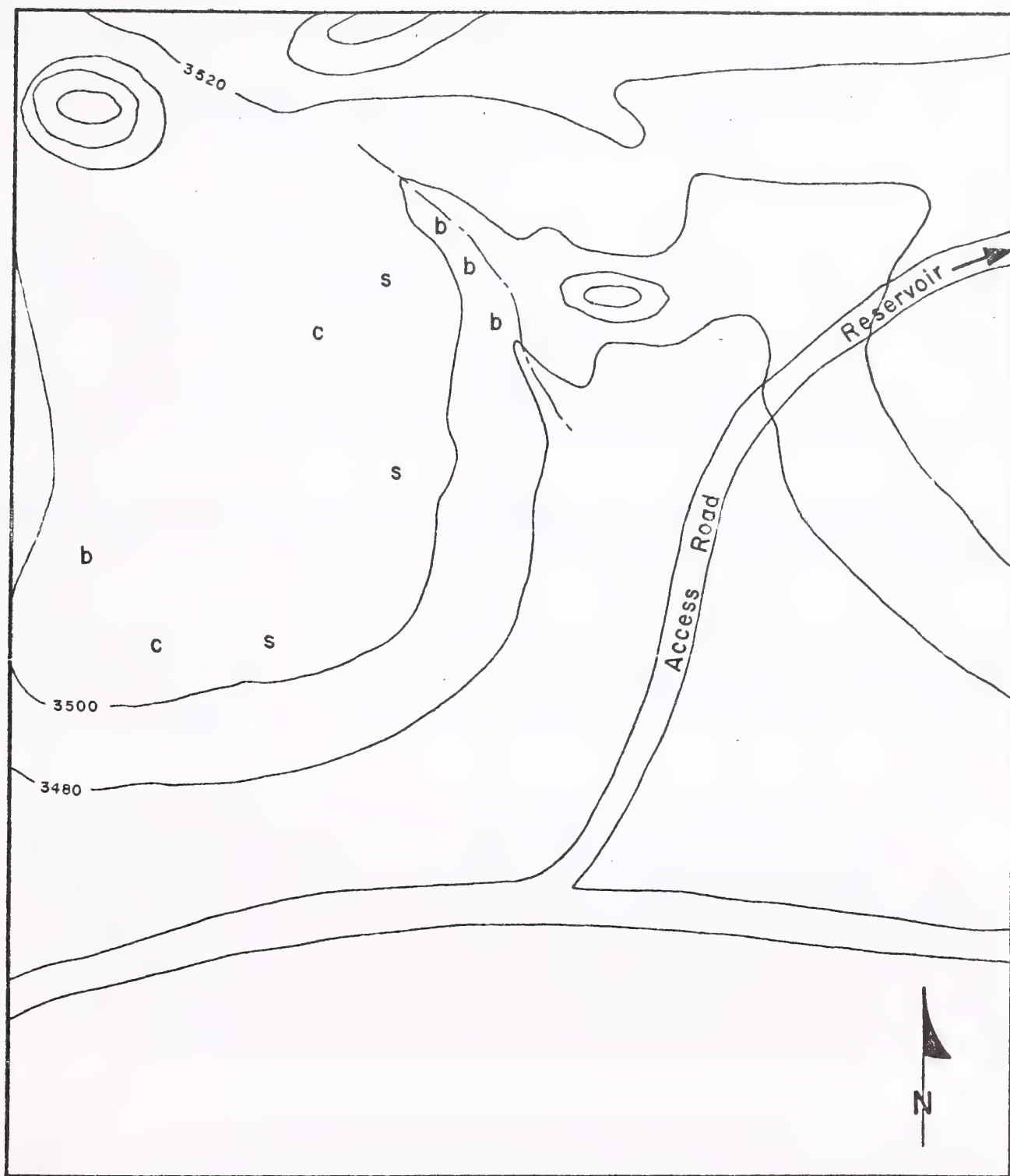


Figure 6.--Location of cultural materials recovered from the All Gone Site; s=scrapper, b=biface and c= core.

approx 10m

Recommendations: No further work is recommended at the site.

24BH1514 Knoll Site

Location: West Decker; T8S, R40E, SW $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 33

Elevation: 3600 feet

Type: Lookout

This site is located in a saddle between two scoria covered points on a high ridge just off the main Decker Highway 338 and above (to the south) of a mine road. The site consists of a small concentration of flaking detritus. Although there are porcellanite outcrops on these ridges, there are actually few concentrations of chipping debris. Usually, as is the case with 24BH1512 and 24BH1513, the chipping is noted on the tops of knolls. Perhaps this site was in the saddle to escape the wind. No flake tools or formally prepared tools were found in the collected material.

Recommendations: A systematic pickup was conducted, the site was photographed and a sketch map made. The site does not merit any additional research.

24BH1515 Lost and Found Site

Location: West Decker; T8S, R40E, NW $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 33

Elevation: 3580 feet

Type: Occupation and Lookout

24BH1515 is located on the northern edge of a high scoria and porcellanite covered ridge west of the Old Tongue River mine. A systematic pickup recovered several tools and 23 primary percussion spalls. No retouched or sharpening flakes were found. The flakes are porcellanite except for one quartzite and one NVN glass spall. The distribution of these artifacts covered an area of approximately 3000 square meters. Two tools, an end scraper, and a biface fragment, were located on the north edge of the hill overlooking the wide grasslands adjacent to the Spring Creek Drainage.

The plano-convex end scraper is made of chalcedony, and is broken with a hinge fracture occurring midway on its length. The fragment measures 3 cm in length, 2.5 cm in width and 1.1 cm in thickness. Pressure retouch scars are evident on the working end and one lateral edge. Fine hinge fracture scars extend 1 mm up from the working edge possibly indicating wear from working hard materials such as bone or wood. The biface fragment recovered is made of grey porcellanite and is also broken in a hinge fracture. The fragment measures 3 cm long, 3.5 cm wide and is 3 cm thick. The complete tool was probably ovoid in shape. Laboratory analysis of the flakes recorded indicates that no modification or use was

made of them.

Recommendations: It appears that 24BH1515 may have served either as a brief camping area or more probably as a lookout station with limited tool manufacture occurring. No hearth rock was noted on the site and the small amount of material suggests that the site was not extensively used. The site has been photographed, sketch mapped, and collected. It is improbable that additional research would provide any significant data.

24BH1516 Darby Site

Location: East Decker; T9S, R41E, NE $\frac{1}{4}$ of the NW $\frac{1}{4}$ of NW $\frac{1}{4}$ of Section 7

Elevation: 3440 feet

Type: Specific activity area

This site was identified by the discovery of two stone tools found with a 5 meter square area with no flakes or any other evidence of prehistoric activity within a considerable distance (Fig. 1). One flake of yellow chalcedony containing black dendrites was retouched on the end to make a perforator. The other flake of yellow chert with black dendrites was retouched and its function is unknown. These two tools were located on the middle one of three sandstone cliffs on the south edge of Deer Creek. The vegetation of the site consists of range grasses, sage, and cactus with numerous juniper trees around the edges of the cliff. The view of the valley is excellent but the presence of only two tools and nothing more suggests at most that a very specific activity was performed at this location.

Recommendations: A sketch map of the site was made and the general area photographed. No further work is recommended for the site since all artifacts were collected. These small sites, even though only a small number of artifacts are found, are valuable to the area's prehistory because of the insight into the use of the area by prehistoric people. In this case, the activity associated with a perforator and a retouched flake of a foreign material might indicate, for example, that someone repaired some article of clothing and similarly, the rare material type may indicate that the individual was just passing through the area and was not a resident. There is no further work recommended on this site.

24BH1517 Yellow Patch Site

Location: West Decker; T8S, R40E, south center of SW $\frac{1}{4}$ of Section 34

Elevation: 3500 feet

Type: Occupation

The Yellow Patch Site (Fig. 7) is located on a relatively high, grass and sage covered ridge and consists of a lithic scatter extending over an area 75 meters and 40 meters wide. An excellent view of the Tongue River

Valley and adjacent lands is gained. The vegetation is sparse and the soil consists of mixed sandstone and clinker. Outcrops of porcellanite occur on low knolls west of the site. A systematic pickup based on 8 meter square grid units was conducted. Lithic material types are predominantly porcellanite with only one flake of chert and one of quartzite material being recovered.

Thirty-eight flakes, one projectile point, three biface preforms, one biface, one retouched flake, and an end scraper were recovered. The projectile point recovered from 24BH1517 is a small side notched flake point commonly associated with Late Prehistoric Period sites. The blade edges are convex, the notches are .2 cm deep and .2 cm wide and the base, though incomplete, was thinned. Artifact measurements and descriptions are listed in Table 3:

Table 3 -- Artifact descriptions from 24BH1517

| Artifact | Length | Width | Thickness | Material | Comments |
|------------------|--------|-------|-----------|-------------------|----------------|
| preform 1 | 2.5 | 3.0 | 1.0 | grey porcellanite | end fragment |
| preform 2 | 5.5 | 3.5 | 1.1 | red porcellanite | periform shape |
| preform 3 | 3.9 | 2.6 | 1.0 | red porcellanite | periform shape |
| biface | 2.9 | 2.5 | 0.5 | grey porcellanite | ovoid |
| keel backed | | | | | distal end |
| end scraper | 2.2 | 2.8 | 0.7 | red porcellanite | fragment |
| projectile point | 2.4 | 1.3 | 0.3 | grey porcellanite | (see text) |

Recommendations: The site was photographed, a sketch map made, the locations of tools noted on the map, and two 8 meter square units were collected (Fig. 7). These two units were selected because they covered most of the thin surface scatter of lithic debitage. A portion of this site is scattered in the sandy saddle of this scoria capped ridge but the lithic scatter there was sparse also. It was not felt that testing was warranted. The soils of the collected consisted of coarse sand and there was no soil deposition to test in this area.

24BH1518 Juniper Site

Location: West Decker; T9S, R40E, SE¼ of the SE¼ of the NW¼ of Section 4

Elevation: 3540 feet

Type: Occupation

A small scattering of flakes was found on the lobe of the second bench on the north bank above Pearson Creek, just to the east of the highway. Vegetation is sparse and has been partially covered by redeposited soil eroded from the slopes above. The site was named for the single juniper tree growing on the slope to the west of the site.

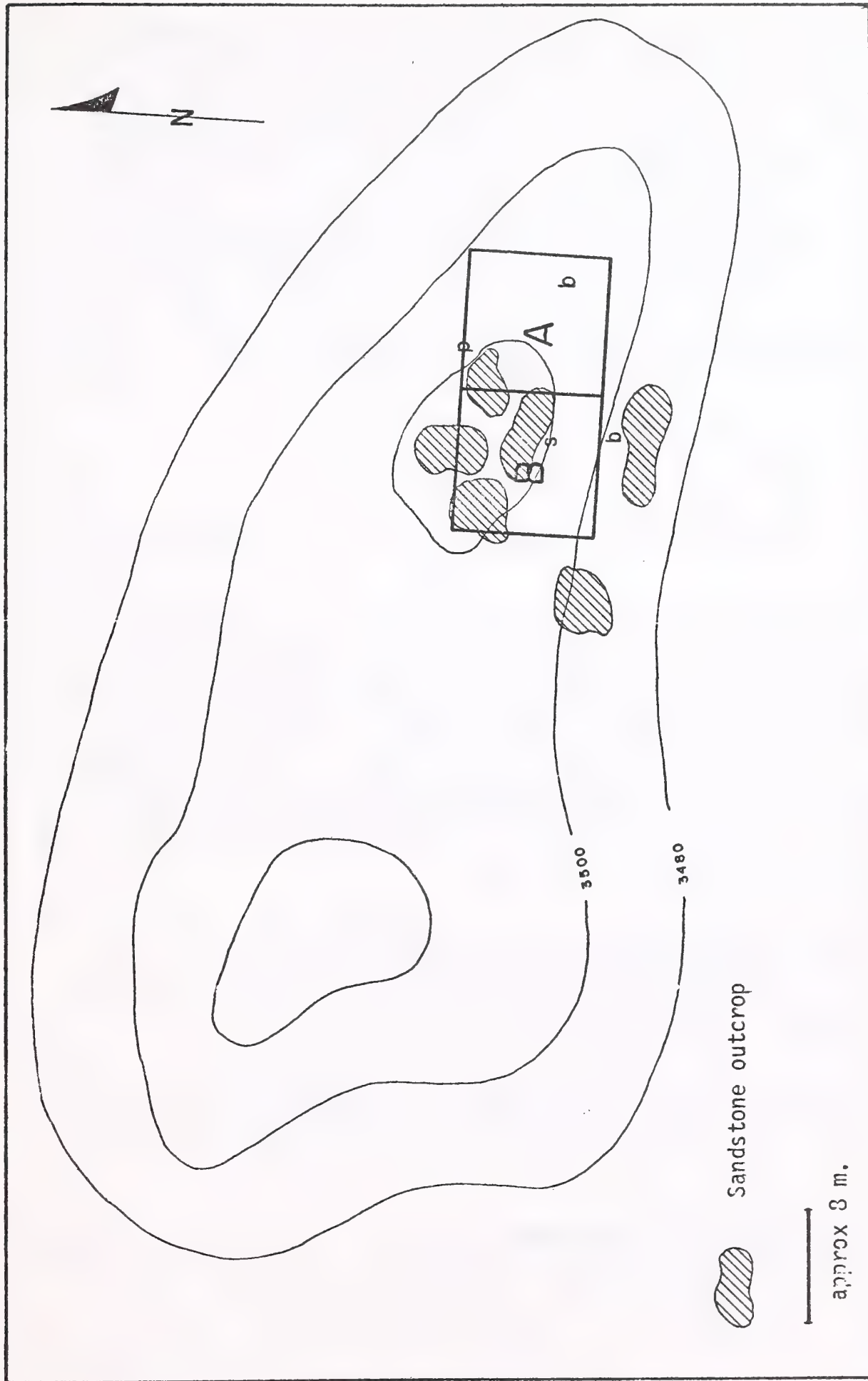


Figure 7.--Sketch map made of Yellow Patch Site showing areas collected (A & B) and locations of tools:
s=scrapper, b=biface, and p=projectile point.

Although the surface soil of the site is an erosional deposit from the scoria-capped hill to the north, the knoll or lobe that the site is on consists of partially exposed sandstone. The lithic scatter was 40 meters by 15 meters in area and was collected in twelve five meter square units centering on the areas of greatest concentration. Thus a greater percentage of the material of the site was picked up. One tool, a straight based, small corner-notched point typologically similar to Late Prehistoric Period types was collected. The flakes generally exhibited large bulbs of percussion and other attributes that indicate they were struck from a core by a direct percussion technique. Few of the striking platforms were prepared.

Recommendations: The site was essentially collected, mapped, and the area photographed. No further work is recommended.

24BH1519 Sonnemaker Complex

Location: East Decker; T9S, R41E, SE $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 5

Elevation: 3540-3664 feet Type: Lookout, Chipping Station, Rock Pile

24BH1519 (Fig. 8) is located on a low sandstone outcrop, a red clinker capped butte, and a grassy flat sloping slightly to Deer Creek. It consists of a concentration of porcellanite flakes and two rock cairns. The high clinker-capped butte has a rock cairn with lichen connecting the rocks. Several flakes of porcellanite and chert were found near this rock pile. Near the east end of the sandstone outcrops a corner-notched point was found. A similar rock pile was located on the north bank of Deer Creek also with connecting lichen. All of these features and artifacts being in such a close area, yet not particularly distinctive individually, were grouped into a "complex" as opposed to a site.

All flakes were picked up and the area photographed. The corner-notched point recovered measures 2.4 cm long from tip to break, 1.8 cm wide and .6 cm thick. The point has a ground, convex base and convex blade edges. The distal end of a biface made of grey porcellanite was also found.

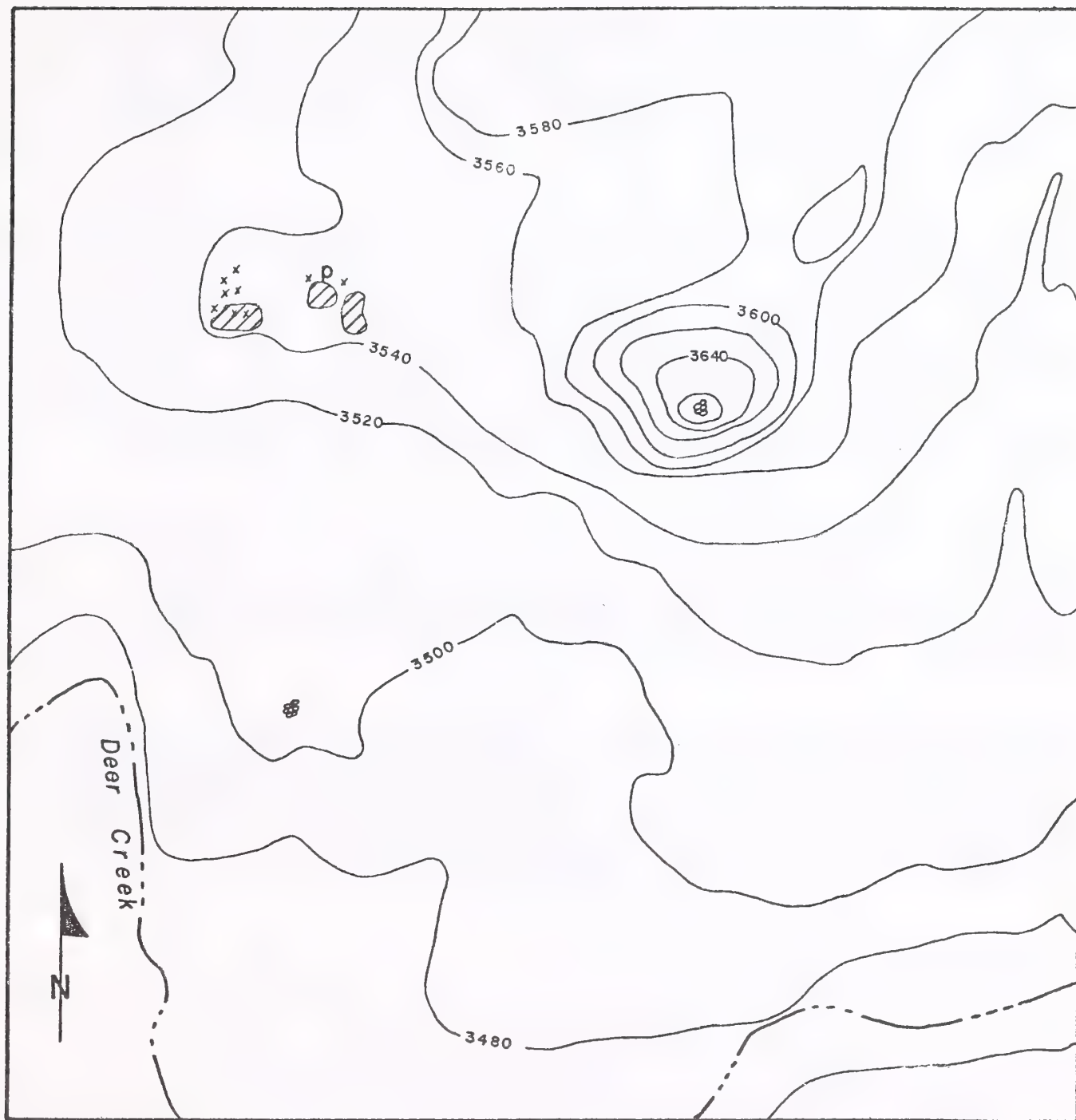
Recommendations: No evidence was noted of subsurface cultural material, and consequently, additional research is not warranted. The rock piles consisted of only a few stones and do not warrant further examination.




24BH1520 Deer Creek Rock Structures

Location: East Decker; T9S, R41E, NW $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 1

Elevation: 3460 feet Type: Rock Structure

The site consists of two rock structures made of sandstone slab



-  rock pile
-  sandstone outcrop
-  scatter flake

approx 100m.

Figure 8.--Distribution of features and artifacts at the Sonnemaker Complex 24BH1519 (sketch map, not to scale).

rock on the lobe edges of the second bench above Deer Creek where it enters the Tongue River Reservoir (Fig. 9). The structure on the southern edge of the grassy knoll appears to have been constructed around the same time that an adjacent rock pile with a wooden stick was made. It measures approximately 2 meters square with the lower (southeastern) side open.

The other structure appears to be considerably older although there are no connecting lichens, and it utilizes sandstone slabs from the immediate area. This structure opens to the west, is roughly U-shaped, and is 2 m wide by 2.5 m long. It may possibly be a vision quest structure but does not fit the normal pattern. Generally, vision quests were constructed on high points of land with a good view of the surrounding area. Also, they were open to the east to greet the moon or morning star. Most Plains and Plateau Indian people at historic contact participated in the vision quest ritual, the Crow and the Cheyenne emphasized the construction of "beds" of U or oval shape.

This older structure does not fit the normal vision quest pattern, nor does it appear to conform to any of the other ethnohistorically known rock structures. This situation is not unusual in a region where numerous rock structures have been discovered which fit no pattern at all. This probably is one more to categorize to an unknown function.

Recommendations: Although a few flakes were noted, they did not seem to be associated with the structure, and they were so widely scattered that no collection was made. The site has been mapped, photographed, and thoroughly recorded. There is no depth to the fill in the older structure to warrant further testing in order to clarify its function. Therefore, no further work is recommended at the site.

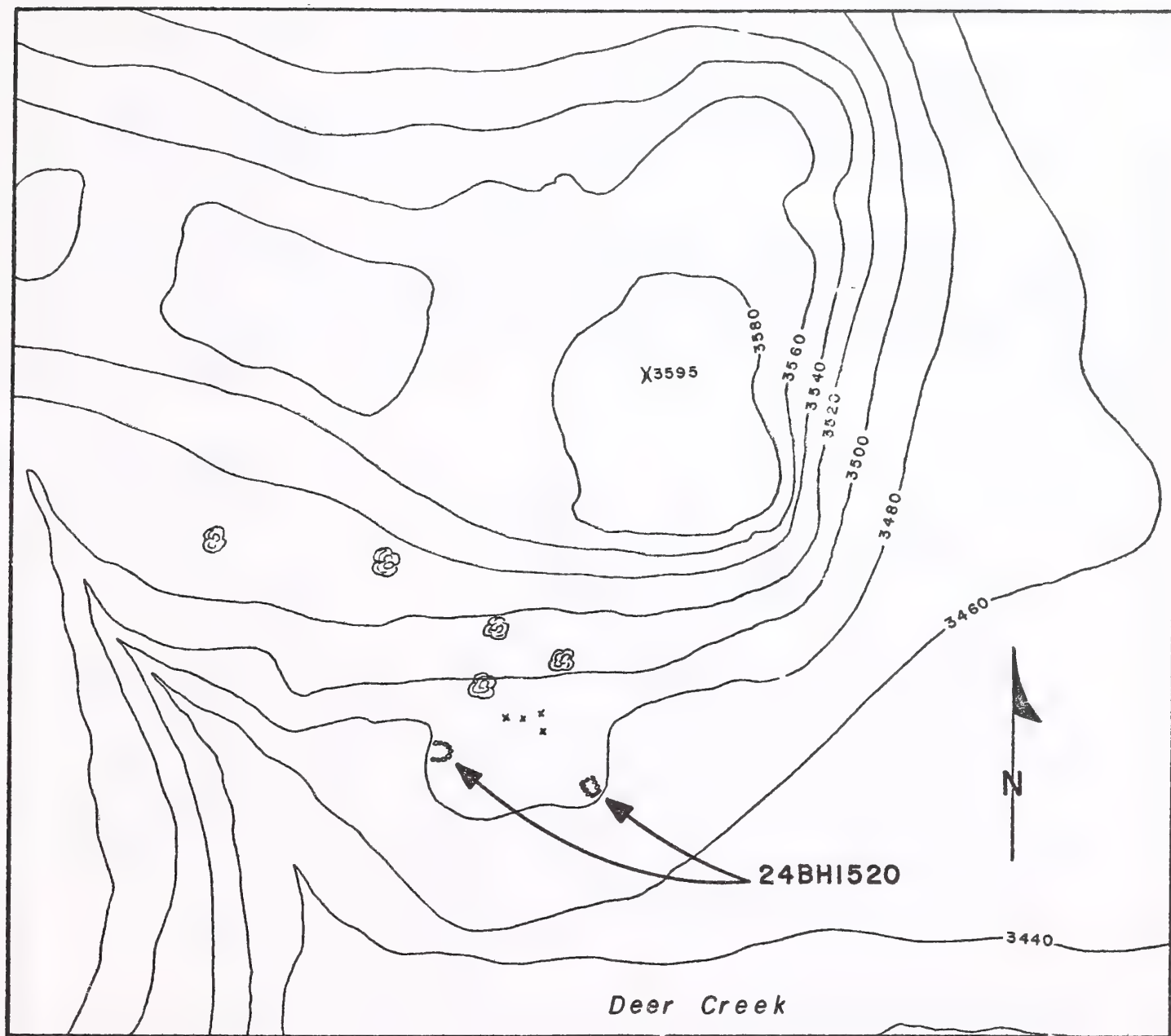
24BH1521 Bad Water Site

Location: East Decker; T9S, R41E, NW $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 5

Elevation: 3620 feet

Type: Occupation-temporary

24BH1521 is located (Fig. 4) on a east-facing washed slope of grey clay at the base of a clinker-capped hill. The site (Fig. 10) consists of a small scattering of flakes and several tools. The flake concentration is scattered over an area about 6 meters by 8 meters. Vegetation on the site is sparse and consists of range grasses, sage and juniper growing on the north slope of the ridge. A total pickup of the site yielded 38 primary percussion spauls, one graver, two scrapers, and one spokeshave. The exact location of each flake and tool has been plotted on a map (Fig 7). Except for one fragment of hematite, all flakes and tools are made of porcellanite. The piece of hematite appears to be worn on the edges. However, the nature of the hematite is that it is so soft that the rounded edges could be caused by weathering. The other two tools are a spokeshave and a graver. The graver exhibits polished edges from wear and pressure retouch scars on one side of the flake



juniper



flake scatter

Figure 9.--Location of rock structures at 24BH1520 (sketch map, not to scale).

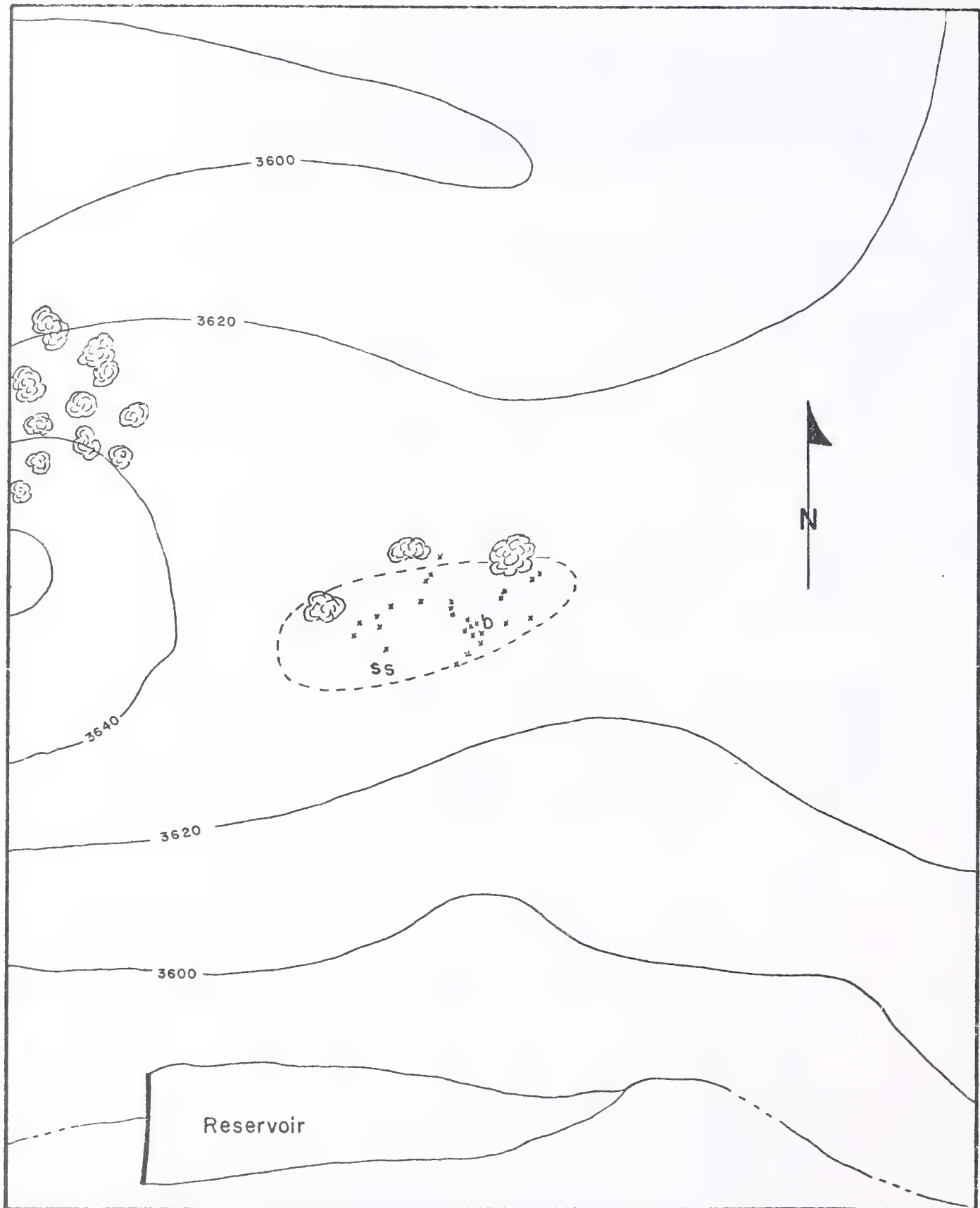


Figure 10.--Bad Water Site 24BH1521 showing distribution of artifacts.



juniper



flake scatter



site area

approx. 15m

extending from the ventral surface upward to the dorsal or back of the flake . The tip of the graver measures 2 mm long and runs along 3 mm of the distal end of the flake. The flake itself is 2.6 cm long, 2.5 cm wide, and .8 cm thick.

The spokeshave is a fairly common tool from the area and this particular one has an asymmetrical notch on one lateral edge of the flake. The notch was made by the removal of pressure retouch flakes and measures 2 mm deep and 1 cm across.

Recommendations: Although some interesting artifacts were recovered on the site, there was no depth to the deposit and the amount of material was scant. A sketch map showing the location of each artifact was made when the site was collected, and photographs were taken. No further work is recommended at the site.

24BH1523 LSA Factory Site

Location: East Decker; T9S, R41E, SE $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 6

Elevation: 3600 feet

Type: Quarry-workshop

On the ridge crests of two hills above the Deer Creek Valley is an outcropping of fused or non-volcanic glass (NVN glass). This material occurs in nodules from 1 to 5 cm in diameter. The main areas of the outcrops appear to be around the edge of the ridge below the scoria rock and above the shelf sandstone. The material is generally green, grey, or black in color with some pieces of red and yellow. These are areas where it appears that considerable working of the material by prehistoric people occurred. These workshop areas are located near the actual outcrops. The site vegetation is similar to other ridge tops with range grasses and sage predominating along with some juniper existing on the slopes.

Examination of the collected areas (Fig. 12) indicated that there were certain areas where working of the material had taken place and other areas where most of the debris collected was natural. One of the areas where considerable workmanship had taken place in the form of rough, percussion flaking was on the eastern edge of the site near a large sandstone boulder which was nice to sit on then as well as now. Other areas where activity had taken place seemed to be along the edges of the ridge. A second outcrop of the material was noted on the first ridge to the northwest (Fig. 11).

NVN glass outcrops sproadically throughout the Fort Union formation and has been used by the prehistoric inhabitants. It's value as a high quality knapping material is somewhat dubious since it shatters easily and though used, it is rare to find finished tools made of the material. It resembles obsidian but, because of the considerable numbers of internal gas bubbles throughout the specimens from this source, it is relatively useless for toolmaking. The less glassy and

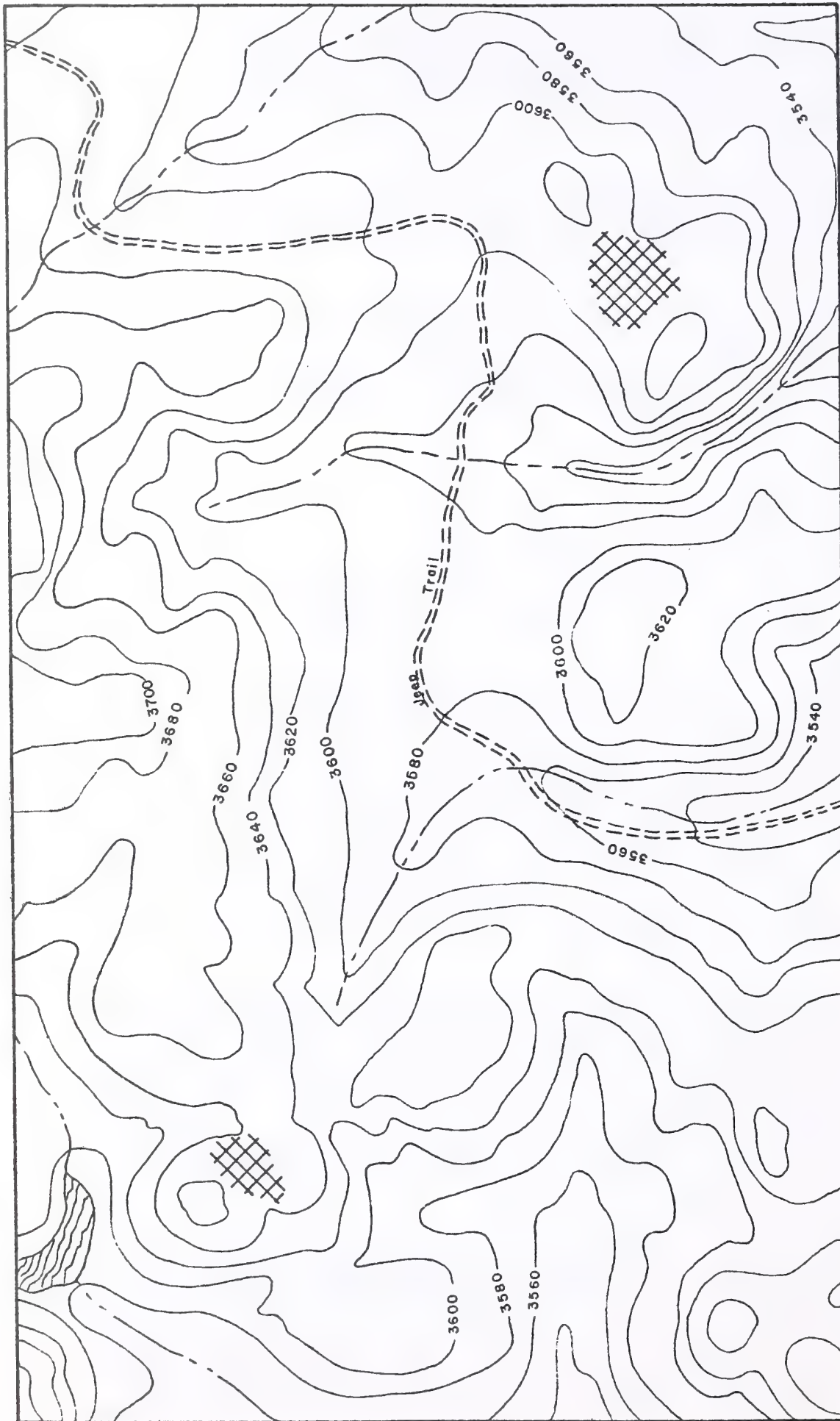
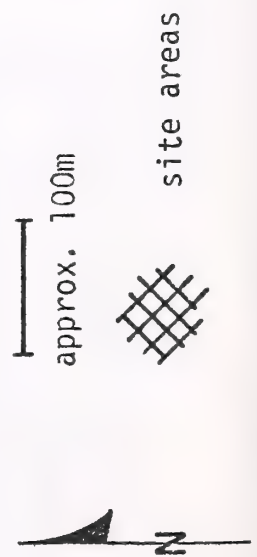


Figure 11.--General topographic location of outcrops of NVN glass at LSA site 24BH1523.



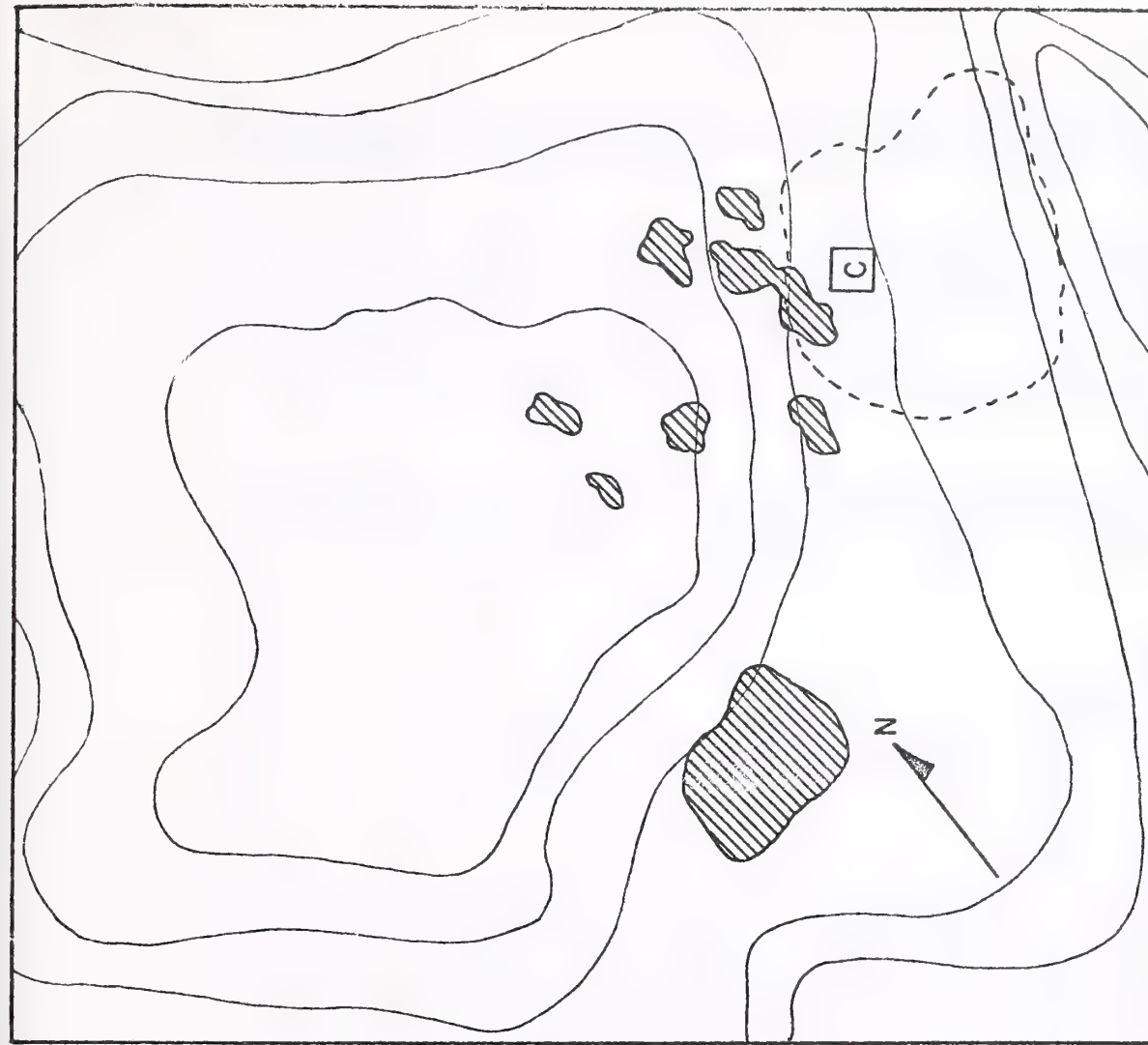
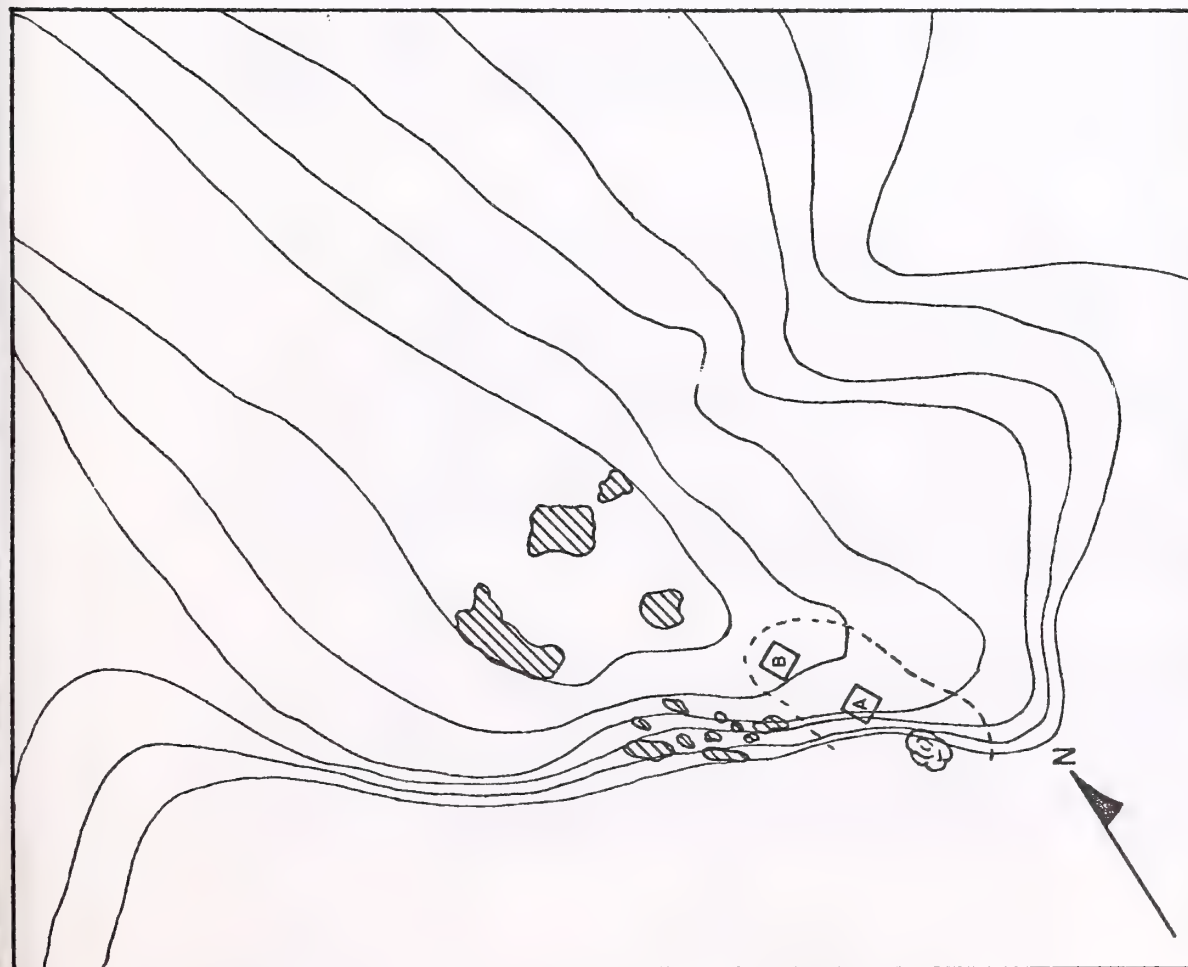






Figure 12.--Location of collection areas of NVN glass at 24BH1523.
approx. 10m.

-  Scoria outcrop
-  Concentration of artifacts
-  Areas collected
-  Juniper

more common grey and red porcellanite was used more frequently as is to be expected. However, it is important to know the locations of NVN glass deposits.

From a careful inspection of the collection from this site it was apparent that although attempts were made to work the material, most flakes are from percussion blows and considerable numbers were broken. Other quarry or outcrop areas should also be examined because the quality and popularity of different outcrops might be noted.

Recommendations: A thorough collection and a map were made of the site. Photographs were taken of the area. No further work is recommended.

24BH1524 Scobie Site

Location: East Decker; T9S, R41E, NW $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 6

Elevation: 3600 feet

Type: Occupation

This site is located along the top of a ridge on the north side of Deer Creek. The cultural debris consists of flakes of porcellanite, fused glass, and cherts, as well as scattered quartzite river cobbles cracked from heat. The surface deposits extend approximately 100 meters along the ridge crest but are generally concentrated within an area about 35 meters long by 15 meters wide. The surface of the site is covered predominantly with range grasses and yucca, while scattered juniper are found around the edges and on the slopes. Two projectile point, several tools, and red quartzite broken cobbles were found and noted on the sketch map.

A complete pickup of the main area of concentration of cultural material (Fig. 13) was done in 5 meter square units. Within two of these units cracked and crazed quartzite cobbles were noted. Examination and testing indicated that the ridge crest had been washed through erosion causing considerable redistribution of the heat fractured rock and totally washing out any charcoal which may have originally been present. A complete pickup of the 675 square meter area of the site yielded 290 flakes and three tools. Except for a single chert flake, all flakes were of the local porcellanite, and non-volcanic natural glass. The one chert cobble showed primary percussion scars on part of its surface.

Two of the artifacts are fragments of bifacially flaked tools but are not identifiable as to type. The single projectile point is a side-notched form made of NVN glass and exhibits rather poor workmanship; this may be due to the nature of the material rather than to the maker. The point was broken in manufacture and measures 2.1 cm long (actual broken length), 2.3 cm wide, and .5 cm thick. It has

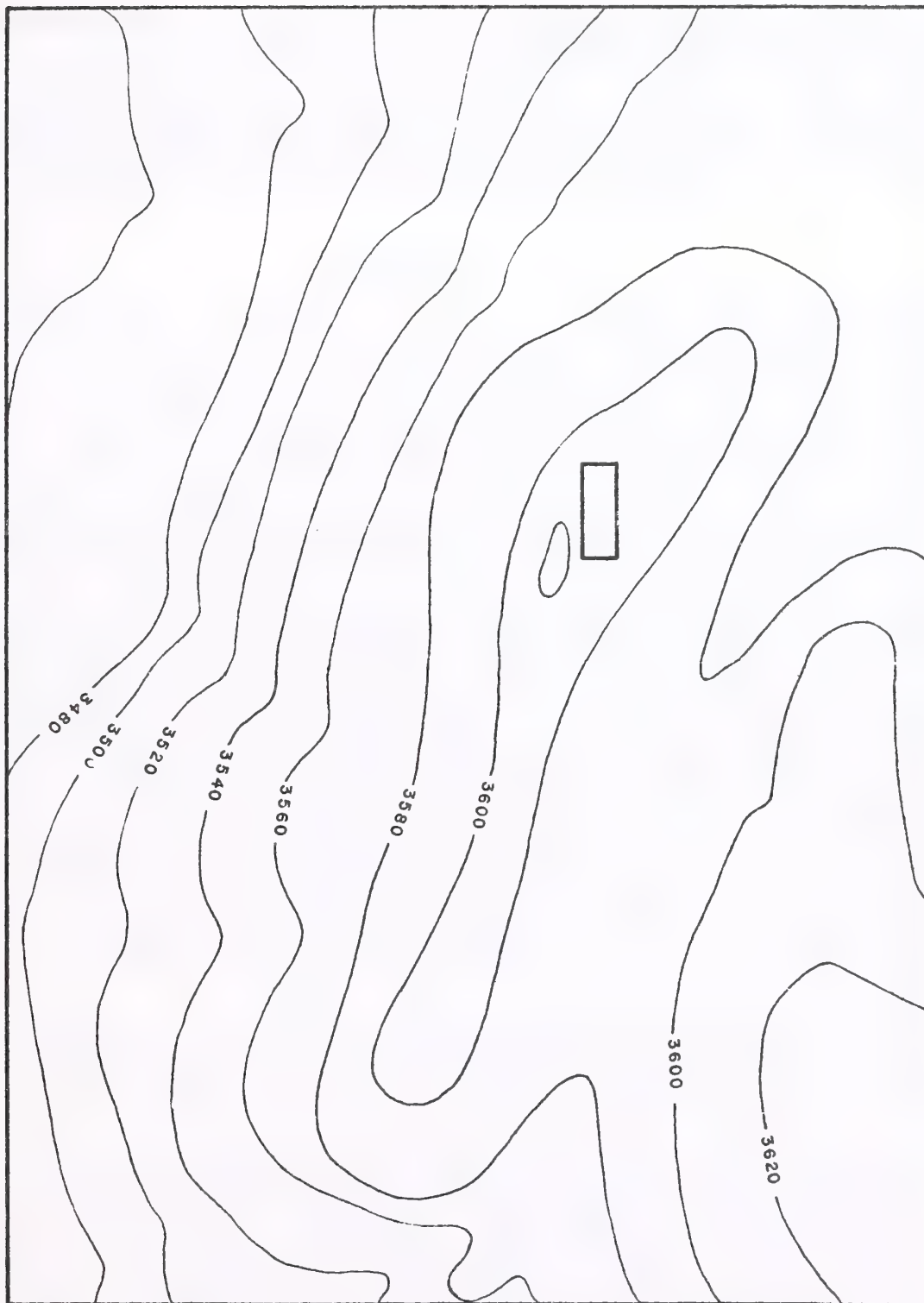
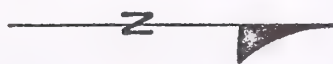


Figure 13.--Distribution of lithics from the collection at the Scobie Site 24BH1524.



Site area

approx 100m.



a wide, convex, curved base and convex blade edges. The distribution of the flakes is indicated on Fig. 9.

Recommendations: The site has been sketch mapped, photographed, tested and a major portion collected. No evidence of subsurface material was present and consequently, no additional work is recommended at the site.

24BH1525 Channel Rock Piles

Location: West Decker; T9S, R40E, NE $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 3

Elevation: 3500 feet

Type: Rock cairns

On the eastern end of the low ridge which runs along the north bank of Pearson Creek there is a line of very low, small rock piles (Fig. 14). These cairns form a slightly arcing north/south line along an extension of the ridge crest for a distance of 100 meters. The piles vary from 2 rocks to 10, with the stones averaging approximately 10-20 cm in diameter. All are from locally available sandstone. Because of the soil buildup around the sandstone and the rather old appearance of the rock piles it is thought that they were not made in recent historic times. However, with only the rock piles to go by, this statement cannot be confirmed. The line of cairns runs along a ridge which partially encircles a small grassy basin. It is thought that the cairns may have been part of an animal (bison, antelope?) entrapment area and this basin was very carefully examined for any evidence of bones or other materials eroding out. Few flakes or other evidence of human activity were observed with the rock cairns.

The view from the site to the east is excellent across the Tongue River Reservoir and to the south across Pearson Creek and the sage and grass flatland. Vegetation on the site is sparse and consists of sage, prickly pear cactus, skunkbrush, sumac, and various range grasses.

Recommendations: Even though the surface was examined very carefully for evidence of bone or cultural material eroding out of the basin, we feel that subsurface examination of the basin is in order to confirm the presence or absence of deeply buried material. The subsurface of the site was not tested last summer because the surface is BLM land and an additional permit is required for testing.

Sites Outside the Project Area

Four sites were located just outside of the survey area. These are marked on the map (Fig. 1). The additional sites are: 1) 24BH1522, the Peak Site which consists of a scattering of flakes on a high point of land; 2) the Bud Site, a very small occupation area on a non-descript ridge within the pine/juniper breaks area; 3) the Rattlesnake

Site, 24BH336, a thin concentration of lithics on a 30 meter square area on a high point of land; and 4) the Horned Toad Site, 24BH337, which appears to be a relatively intensely occupied location also in the juniper/ponderosa pine breaks. These sites will be fully examined during the 1976 field season.

SUMMARY

A total of 14 sites were located within the survey boundaries and 4 were located just outside the survey area. None meet the criteria established for recommendation to the National Registry of Historic Places. (36 CFR 800.10). Most of the sites represent occupation or general camping activities. Some sites were special activity areas, such as the Deer Creek Rock structures which might have been vision quest sites. Further survey in the immediate area in 1976 should broaden this site information base considerably.

From the distribution of prehistoric sites found on the 1975 Decker survey and other surveys in the adjacent Wolf Mountain area, several factors become apparent relating to the choice of areas for camping and other activities. As has been noted by other archaeological surveys (Loendorf, Barnett, and Larson 1972; Haberman 1973) there is a relatively intensely occupied zone in the lower to middle altitudes of the Wolf Mountains within the juniper/ponderosa pine breaks. The higher open grasslands of the Wolf Mountains yielded very few sites giving the indication that it was used rarely both before or after the introduction of the horse. The Decker survey located sites both on shelf-like or massive sandstone outcrops on the grassy ridges or broken scoria outcrops near or within the juniper breaks. No sites were located on the open lower grasslands.

Another feature which is important in site location is that sites tend to be located on the southfacing slopes of ridges. For instance, no sites were found along the rimrocks and hills on the south side of Deer Creek (the north slopes of the Badger Hills), yet numerous sites were found in the hills on the north side of the creek. Since the prevailing winds in this area are from the north and west the choice of the southern slopes is understandable, particularly if the located sites represent winter or early spring occupations. South or eastfacing slopes were often chosen for rock shelter occupations in order to capture the morning sun.

Rock piles were noted throughout the surveyed lands but were not given site numbers unless there was lithic debris or other identifiable features associated with them. Two rock piles are included as part of 24BH1519 and on the Channel Rock Piles Site (24BH1525) all rock piles were mapped carefully, some being made up of only two or three stones. At least five other rock piles were noted on the surveyed areas but because of the problem of identifying their antiquity and since they have been commonly built by

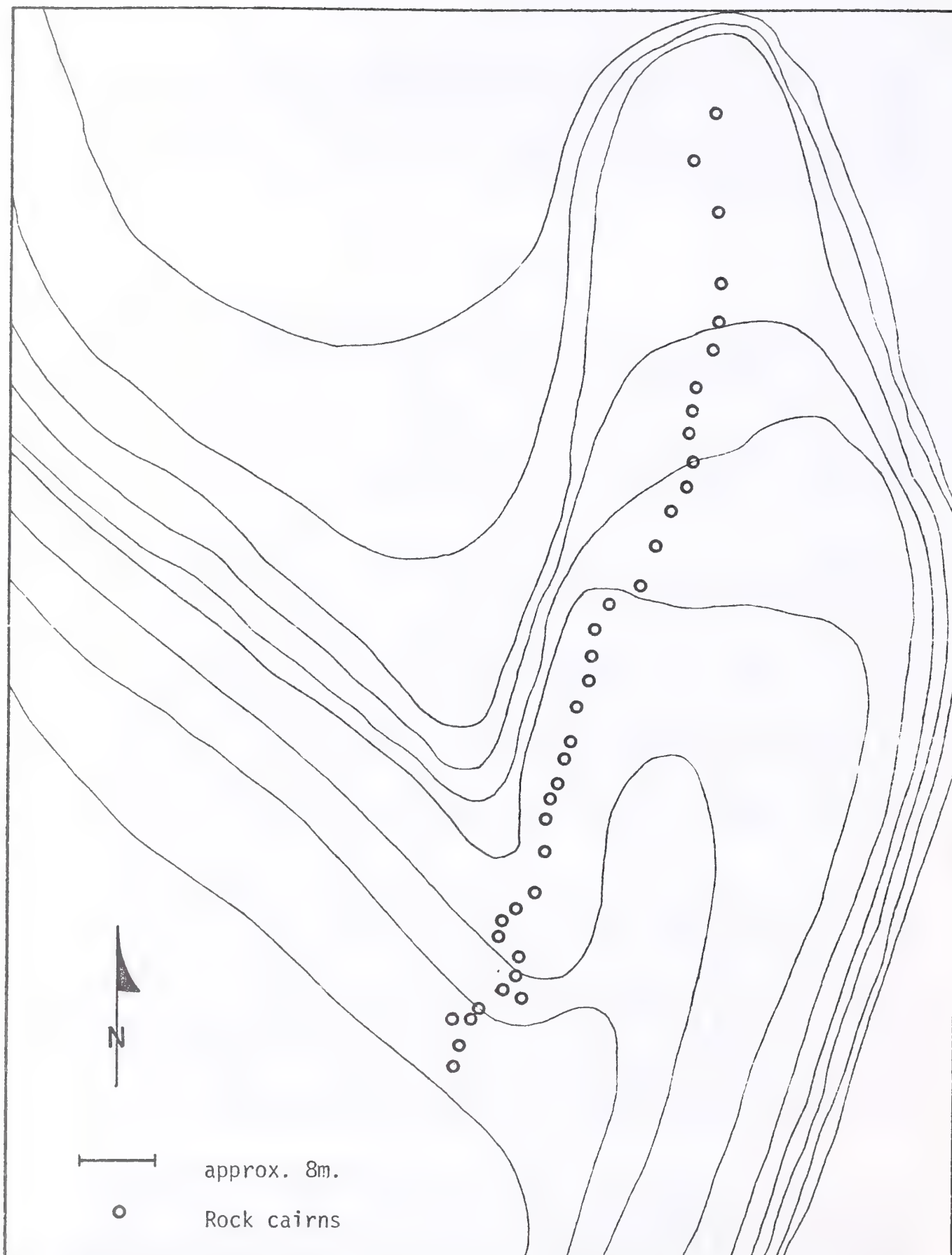


Figure 14.--Location of rock piles on the Channel Rock Piles Site 24BH1524.

ranchers, shepherders, and children they are rather ubiquitous.

Only one rock ring site (24BH1510) was found and this consisted of parts of the remains of five stone circles. These types of sites are fairly common throughout the northern Plains, generally being interpreted as circles left from rocks placed to hold down the edges of skin tipis. There is some question as to whether all stone circles were built for this purpose or not. Four of the five circles reported here contained several rocks grouped together near the center of the rings and are interpreted as being related to fire hearths. Rarely is charcoal found with these stones since they are on the exposed surface and wind would soon blow the charcoal off. Stone circles with smaller diameters are thought to be generally connected with Late Prehistoric and earlier occupations since large tipis would be constructed only after the introduction of the horse. From several sites there is indication that stone rings were used much earlier. For instance, at the Hell Gap Site, stone circles were associated with a cultural level dating to 6400-6000 B.C. (Irwin-Williams, et al, 1973). Thus, unless diagnostic artifacts are found associated with rock rings it is difficult to assign them to a temporal classification.

The third type of site associated with rock structures was 24BH1520. One of the structures was quite clearly historic but the other appeared to be considerably older and might be an aberrant type of vision quest structure or something entirely different.

The last type of site located was the LSA Quarry Site. This was an outcrop of nodules of non-volcanic natural glass which occurs commonly in the area, and is formed when certain conditions are met from coal burning underground. This material is often found at occupation sites and was used by the prehistoric inhabitants. The prehistoric utilization of NVN glass was not as common as the use of the porcellanites. However, locations of the NVN glass sources is important in attempting to measure the distances which people transported the material.

The types of sites noted vary from small flake scatters extending over a few square meters to as much as 100 meters in length. Some sites, such as 24BH1514, consist of flakes with very few tools, and could be chipping stations or places where a hunter stopped to watch for game movement on the grasslands and engaged in tool fabrication while he waited.

Other sites appear to have had specific activities associated with them. For examples, 24BH1516 or 24BH1511 had very few flakes or lithic detritus in relation to the number of tools. This may suggest that chipping or even sharpening of tools was not carried out but perhaps another activity such as hide preparation or clothing repair was accomplished instead.

Only one site required any extensive revisiting and this was 24BH1524, the Scobie Site, since there was some evidence that fire-burned rock was eroding out from the surface. This site was collected systematically, and the area of the eroding hearth was examined by troweling portions in a systematic manner. From this investigation the shallowness of the deposit and the knowledge that the surface collection would almost totally recover all cultural material at the site was confirmed. Thus, no other work was done at the site.

A variety of different types of sites were located and recorded, yet only a few of these produced temporally diagnostic cultural materials. In all cases where cultural cross-dating was possible, the site occupations fell into the Late Prehistoric Period (A.D. 500-1800) and were represented by small side- and corner-notched projectile points. The numerous occupation sites represent a wide variety of activities and further study of the lithics from the sites will be conducted in conjunction with the 1976 fieldwork. Additional analyses of lithics from each individual site should yield additional information on techniques of tool fabrication.

This report has discussed in detail the various sites and our recommendations and reasons for the recommendations for each site. The conclusions are looked upon as preliminary, however, until the 1976 survey is completed. Data from this and the 1976 report will be combined and a more complete analysis of all of the materials will be published by the Mineral Research Center, Montana College of Mineral Science and Technology Foundation.

Table 33A.--Archaeological sites and selected attributes for the East Decker and North Extension areas

| Site number and name | Location | Site type | Site area (meters) | Distance to water | Ecological association | Artifacts & features |
|---------------------------------------|--------------------------------------------------------------------------------|----------------------------------|--------------------|---------------------|------------------------|------------------------------------------------------------|
| 24BH1510 Three Deer tipi rings | NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4 T. 9 S., R. 40 E. | Occupation | 100 x 300 | 100 (seasonal) | Rolling grassland | 1 biface preform 1 biface end fragment 5 stone rings |
| 24BH1511 All Gone site | NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 34 T. 9 S., R. 40 E. | Occupation (limited activity) | 20 x 50 | 1,000 (seasonal) | Ridge- juniper | 3 end scrapers, 2 cores 3 bifaces, 1 perform |
| 24BH1512 Fat Albert site | SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 33 T. 8 S., R. 40 E. | Lookout | 100 x 100 | 330 (seasonal) | Ridge- juniper | ---- |
| 24BH1513 Puppy site | SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 33 T. 8 S., R. 40 E. | Lookout | 600 x 600 | 330 (seasonal) | Rolling grassland | ---- |
| 24BH1514 Knoll site | NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 33 T. 8 S., R. 40 E. | Lookout | 600 x 600 | 330 (seasonal) | Rolling grassland | ---- |
| 24BH1515 Lost & Found site | SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 33 T. 8 S., R. 40 E. | Lookout/ Occupation | 50 x 100 | 250 (seasonal) | Rolling grassland | 1 end scraper 1 biface |
| 24BH1516 Darby site | NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 7 T. 9 S., R. 41 E. | Limited activity | 5 x 5 | 10 (seasonal) | Ridge- juniper | 1 perforator |
| 24BH1517 Yellow Patch site | E $\frac{1}{2}$ SW $\frac{1}{4}$ sec. 34 T. 8 S., R. 40 E. | Occupation | 40 x 75 | 330 (seasonal) | Grassy ridge | 3 biface preforms, 1 biface, 1 point, 1 end scraper |
| 24BH1518 Juniper site | SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 4 T. 9 S., R. 40 E. | Occupation | 10 x 30 | 250 (seasonal) | Grassy ridge | 1 corner-notched point |
| 24BH1519 Sonnemaker complex | SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 5 T. 9 S., R. 41 E. | Varied activities | 50 x 500 | 250 (seasonal) | Ridge | 1 corner-notched point, 1 biface fragment |
| 24BH1520 Deer Creek rock structure | SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 1 T. 9 S., R. 40 E. | Rock structure | ---- | 30 | Rolling grassland | 2 rock structures |
| 24BH1521 Bad Water site | NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 5 T. 9 S., R. 41 E. | Occupation | 6 x 8 | 500 (seasonal) | Ridge- juniper | 1 graver, 1 spokeshave, 1 hematite object |
| 24BH1523 LSA Factory site | NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 5 R. 9 S., R. 41 E. | Quarry workshop | 100 x 500 | 1,000 | Ridge | ---- |
| 24BH1524 Scobie site | NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 6 T. 9 S., R. 41 E. | Occupation | 15 x 100 | 300 | Ridge | 1 point, 1 biface, 1 point fragment Eroded hearth |
| 24BH1525 Channel rock piles | NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 3 T. 9 S., R. 40 E. | Rock cairns | 100 | ---- | Ridge- grassland | Line of rock cairns |

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Field survey techniques for the 1976 archaeological surface reconnaissance in the proposed East Decker and North Extension areas

Larry Lahren, under contract to the U.S. Geological Survey, evaluated the impacts of coal development on the cultural resources of the Northern Powder River Basin (Larry Lahren, written communication, December 3, 1976). That evaluation included an archaeological surface reconnaissance of the proposed Decker mine areas.

Lahren's contract with the U.S. Geological Survey required only that cultural sites be identified and that appropriate recommendations regarding the testing, collection, or preservations of such sites be made. Accordingly, the only available information for sites identified by Lahren is listed in table 33B and in the section on mitigation of impacts to archaeological sites (VIII.C.G.).

The following is a description of the survey methods used by Lahren in his study for the U.S. Geological Survey (Larry Lahren, written communication, December 23, 1977).

The basic field method that we utilized in the recon is known as an extensive survey. An extensive survey is defined as being "exploratory" which means that in "using this type of survey, the inventory of sites obtained is not complete, and many unrecorded sites probably exist within the survey area" (Mueller 1974:4). Therefore, this type of reconnaissance cannot judge the importance of sites, because it only yields minimal impressions. Furthermore, it is not adequate to totally define the impacts. An intensive survey (which has been implied in many reports for SE Montana but not actually conducted) "results in a complete inventory of sites in which all sites in the surveyed area are recorded" (Mueller 1974:4).^{1/} This type of survey involves detailed testing and will result in defining the extent and importance of the sites. It does not mean shallow test pits or random core drilling.

^{1/} Mueller, J. W. 1974, The use of sampling in archaeological survey. Memoirs of the society for American Archaeology No. 28, American Antiquity, Vol. 39, No. 2, Pt. 2, Washington D.C.

APPENDIX I

CORRESPONDENCE REGARDING
ARCHAEOLOGICAL AND HISTORIC RESOURCES

APPENDIX I

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Larry A. Lahren, *President*

December 3, 1976

To Whom It May Concern:

The following communication is presented as a follow-up concerning my assertions that the archaeological-historical section of the draft environmental impact statement for the East Decker and North Extension mines has some apparent shortcomings. It is furthermore a result of my telephone conversations today with Brace Hayden, Montana Department of State Lands and Mr. Jack Reed of Decker Coal concerning what procedures should be followed at this point in relation to the additional, specific cultural resource locations.

In order to discuss the situation from a proper perspective it is important to clarify certain assumptions and methods which underwrite my assertions. They are:

(1) An archaeological site is "the smallest unit of space dealt with by the archaeologist and the most difficult to define. Its physical limits, which may vary from a few square yards to as many square miles, are often impossible to fix. About the only requirement ordinarily demanded of the site is that it be fairly continuously covered by remains of former occupation, and the general idea is that these pertain to a single unit of settlement."
(Willey and Phillips, 1958.18).

(2) The basic method utilized to locate existing cultural resources on the survey areas defined by USGS solicitation 5819 (one of which was Decker) consisted of an extensive, on-foot, reconnaissance which is based entirely upon surface indications.

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Operating from these assumptions and techniques we located the following additional cultural resources on the proposed mining area:

| <u>Type</u> | <u>Location</u> | <u>Recommendation</u> |
|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------------|
| 1. Ridgecrest Habitation | T8S R40E NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ Section 34 | Surface collect. |
| 2. Ridgecrest Habitation. | T8S, R40E NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ Section 34 | Surface collect. |
| 3. Ridgecrest Habitation | T9S, R40E NW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ Section 3 | Surface collect. |
| 4. Stream Terrace | T9S, R40E SE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ Section 3 | Surface collect and test. |
| 5. Ridgecrest Habitation | T9S, R40E NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ Section 14 | Surface collect. |
| 6. Ridgecrest Habitation | T9S, R40E SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ Section 14 | Surface collect. |
| 7. Stone lines (probably leading to a bison kill) Stone circles and Stone cairns | T9S, R40E NE $\frac{1}{4}$ Section 13 | Photo, map and test. |
| 8. Stream Terrace Open Camp | T9S, R40E W $\frac{1}{2}$ NE $\frac{1}{4}$ of SW $\frac{1}{4}$ Section 14 | Surface collect and test. |
| 9. Historic Homestead | T9S, R40E SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ Section 14 | Photo and possible preservation. |

On surface evidence site number 7 of the above appears extremely complex and worthy of intensive testing which may yield evidence that would qualify it for the National Register. It obviously meets contract specification III D (USGS Solicitation 5819) stating that "all types of cultural resources predicted to exist, or tentatively identified within the area described

ANTHROPOLOGOS RESEARCHES INTERNATIONAL
Incorporated

in section III B, shall be described and evaluated in sufficient detail to permit the Geological Survey, in consultation with the State Historic Preservation officer, the National Park Service and the Advisory Council on Historic Preservation, to determine the need for intensive surveys or other further studies upon receipt of mining plans".

Furthermore it is prima facie evidence which invalidates the statement that "Sections 13 and part of 14 T9S R40E, Bighorn County, Montana were carefully and systematically surveyed and no evidence of prehistoric occupations was noted" (Appendix B of the 1975 Archaeological Survey and Testing of Decker Coal Lands, Big Horn County Montana, Final Report).

It is my professional opinion that if these sites (especially the obvious number 7) were missed during the previous "intensive" archaeological survey, that many others may have been overlooked. Hence I would personally not feel comfortable about the cultural resource evaluations as they presently stand.

An additional item that bothers me concerns the wide range of variation in the signature of the principal investigator (see attachments). It makes me wonder who actually signed Appendix B of the Decker study and who actually did the work, that is, who is legally responsible for the contractual obligations and archaeological evaluations.

Sincerely,

Larry A. Lahren, PhD

Larry A. Lahren

copies to: Bob Sutton
Jack Reed
Brace Hayden
Burt Williams
Charles Albrecht

LAL/cs

Enclosures

WESTERN INTERPRETIVE SERVICES

ALL MAIL TO:
P. O. Box 6467
Sheridan, Wyoming 82801

COMPLETE INTERPRETIVE SYSTEMS PLANNING

307 674-4504

OFFICES AT:
Suite 207
48 N. Main
Sheridan, Wyoming 82801

November 19, 1976

Mr. Jack Reed
Mining Division
Peter Kiewit Sons' Co.
104 South Main
Sheridan, Wyoming 82801

Dear Jack:

For your records, here are our reactions to the reported statement by Harley Sorrels of Montana Fish and Game Commission at the Billings hearings on the Decker Mine extensions:

First, we are confident our own historical reports on the property are not only substantial but exhaustive. It is our contention that no historic events have occurred there, and that none of the structural remains of the recent farming and ranching activity possess any significance through either association or architecture.

As to the archeology, we should make clear the following relationship of archeological studies in the area:

The first substantial archeological effort was a regional one, prepared by a team headed by Dr. Lawrence Loendorf (then of the University of North Dakota, now with the NPS in Denver). They did a limited amount of survey and sampling at various points in the whole Decker/Birney strip, including some limited work on the property. This work was done for the BLM. Then at a later date, our own firm prepared a Preliminary Archeological Reconnaissance on the area that defined various levels of sensitivity in terms of the probable occurrence and survival of various kinds of sites, and recording certain surface manifestations based on limited transects of the entire property. This study was one of the first applications of the sensitivity level concept to a reconnaissance preliminary to a mining plan in this region, but the technique is well established in other areas and gaining ground here.

Still later, the Mineral Research Foundation of Butte prepared for your firm a survey and test project based on the draft mining plan as it existed in the summer of 1975. You have appended their report to the EIS.

We are quite confident that the personnel, systems and techniques used at each level were among the best available in the region. It is our opinion that for the level of effort required at each stage each of the above studies was entirely appropriate to the job at hand. We would feel the primary role of the archeological studies for a project of this kind consists of making a really significant reduction in the probability that any number of important sites would be disturbed by mining or related activities before they could be investigated.

We feel that these studies have done just that. It is always possible that additional buried sites might be encountered in any extensive surface disturbance such as this, but your plan takes this into account adequately for the present EIS, so far as we can see.

Now it is our understanding based on newspaper reports, that Harley Sorrells (who is an exhibit artist employed as curator of the Plenty Coups Museum of Montana Fish and Game Commission) criticized the archeological work upon the basis of alleged discoveries by another archeologist, Larry Larron, who has been involved in various projects in the region within the past season. Larron has supposedly discovered a buffalo jump, and several minor sites.

In a phone conversation yesterday, Lynn Fredlund said to me that she had attempted to get Larron to identify the site and its location so that she might see if it was in the study area for this project, but that he has failed to deliver any specifics of location or nature of the site. In the absence of such data we do not feel such a report can be a valid criticism of the work that the Fredlunds and others have done.

We believe part of the problem at hand lies in the fact that some parties (evidently such as Sorrells) for whatever reason are of the impression that total recovery of every shred of archeological data is a necessity. We have in our files and library abundant documentation for the alternative concept that is held by some of the best archeologists in the country, i.e. that efficient surveys, good sampling and effective systematization of data from these constitutes an approach that is both more efficient and more productive of meaningful scientific results than total-collection of artifacts and data from extensive areas. We would additionally comment that total archeological data recovery cannot be justified cost-effectiveness-wise to the ultimate consumer who always pays the bill!

We expect that the Fredlunds will have further comment when they are able to examine the full contents of Sorrells' statements.

If we can be of further assistance to you in this matter, please let us know.

Cordially,

Robert A. Murray

MINERAL RESEARCH CENTER

Post Office Box 3708 • (406) 494-2778 • Butte, Montana 59701

December 3, 1976

Mr. Leo Barry
Department of State Lands and Investments
1625 11th Ave.
Helena, MT 59601

Dear Mr. Barry:

After reflecting on the discussion at our meeting of yesterday, regarding the Lahren challenge to the adequacy of the Decker EIS, we felt that we should consolidate our various reasons for rejecting any claim of inadequacy relative to our archaeological work.

Basically, Mr. Lahren states that our survey was inadequate because: 1) we failed to locate seven (7) archaeological sites on a survey of approximately 6000 acres, and 2) we do not judge certain located sites to have as great a significance rating as Mr. Lahren judges them to have.

We know that our Decker survey work was equal or superior, in both design and intensity, to any survey conducted in Montana to date. We feel that our field assistants were competent in noting archaeological site locations.

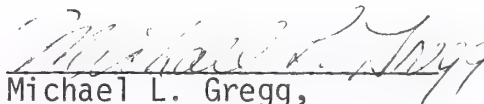
Any archaeological survey of a large tract of land will fail to locate and record some traces of prehistoric human activity. Our survey was done in the spring of an exceptionally wet year, and, consequently, vegetation was extraordinarily dense. This dense vegetation may possibly have obscured some sites along the creek bottoms; sites that would be visible at another time of the year.

Our goal in archaeological survey is to maximize the possibility that no significant site goes unrecorded while locating and recording thoroughly the maximum amount of archaeological site information. One hundred percent recovery is not possible, although all field archaeologists aim for total recovery as an ideal.

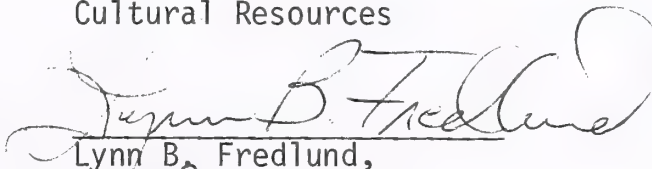
Instead of viewing the additional site information recorded by Lahren for Decker as an inadequacy, the site data should be viewed as additional information which could be gathered by a resurvey of any previously surveyed tract of land. It would be ideal, as a matter of general practice, for a dual archaeological survey to be conducted for any given cultural resource inventory: different surveys in different years and in different seasons. However, because such a procedure is excpetionally expensive and, consequently, cost and time prohibitive, such procedures are not implemented.

We will try to get our final report on this East-West Decker survey (including Lahren's information) and the final Holmes-Decker work compiled andin to you by the end of January, 1977. We hope this will solve some of the difficulties for your department.

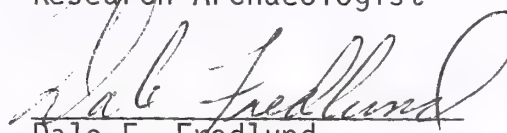
Sincerely,



Michael L. Gregg,
Manager, Archaeology and
Cultural Resources



Lynn B. Fredlund,
Research Archaeologist



Dale E. Fredlund,
Research Archaeologist

hp

MINERAL RESEARCH CENTER

Post Office Box 3708 • (406) 494-2778 • Butte, Montana 59701

January 7, 1977

Brace Hayden
Dept. State Lands
Helena, Montana 59601

Dear Brace:

After reviewing the information from Mr. Lahren's USGS survey regarding the additional sites located on the East & West Decker Survey, we examined the field notes of persons who surveyed in the area of the additional sites. On the West Decker area, our field notes report scattered flakes and an occasional tool in the vicinity of these additional sites. This would appear to be consistent with what Mr. Lahren has called and observed and is calling a site. It seems as we previously suspected, that we are running into the problem of site criteria and definitions, particularly since the surveyors who covered these areas were all experienced and highly qualified people.

The notes of the surveyor who covered the East Decker area do not note anything in the area where these additional sites are located and until we have an opportunity to examine that area, we cannot comment on these sites.

It is our feeling that until more information is obtained, the best course of action is to assume that all are sites. We have no objections to including them in our final report as such, and we will conduct the same research (sketch map, collect, photograph, and test) the sites as well as any additional steps that you would recommend as soon as weather permits.

As we have previously mentioned, criteria used in defining a site is always subjective and must, by necessity, change with each area to be meaningful. It is a decision which must be made by each archaeologist in any project area. Unfortunately, no one archaeologist can agree with another as to what criteria is adequate. The criteria that we used in determining a site was that within a three

(3) meter square area, there must be:

- a. two recognizable tools with associated flakes and/or
- b. 15 flakes and/or
- c. a feature (hearth, rock structure, rock ring, etc.).

Obviously, this is still relatively subjective but our crew appeared to understand and could work with these criteria quite well.

If we can be of additional help, please call us at any time.

Sincerely,



Lynn B. Fredlund
Research Archaeologist

LBF/hp

University of Montana
Missoula, Montana 59801
(406) 243-0211

December 8, 1976

Mr. Brace Hayden
Environmental Coordinator
Department of State Lands
Helena, Montana 59601

Re: Comments on Draft Environmental Impact Statement, East Decker and
North Extension Mines, Decker Coal Company, Big Horn County, Montana.

Dear Mr. Hayden:

One suspects that if Fredlund's 1975 Final Report had been available for inclusion within the Draft EIS some of Mr. Lahren's critical comments would not be appropriate. Lahren does not locate any of those additional sites which he found, but it is possible that his "network of stone lines, rock cairns and stone circles" is the same as Fredlund's site number 24BH1525. This site, the Channel Rock Piles, was not included in the published draft. Also, it could be that the "Five ridgecrest prehistoric habitations sites" mentioned in Mr. Lahren's letter are the five (the number of circles changed from two as reported in the Draft EIS) tipi rings along the ridge at site 24BH1510. It is a little difficult to see how survey missed an historic homestead.

Fredlund's research proposal and the methodology as described appear to be adequate for the project. We have no real way, beyond the inferences that one might draw from the report, to assess the archaeologist's field performances, competence, and the soundness of some judgments. It seems reasonable to me to expect that survey might miss a few sites within any area. Many uncontrollable factors, such as the presence or absence of plant cover, active wind-blown deposits, animal and/or human activities, might obscure or reveal cultural deposits. Sampling surveys, as discussed by Mr. Murray of Western Interpretive Services, may or may not always be adequate. King (1975, Cultural Resource Law and the Contract Archaeologist, p. 12) suggests that when an area is impacted "the archaeologist is responsible for taking whatever steps are necessary to assure that the survey identifies all the cultural resources that it is possible to identify using available methods and under existing circumstances."

The last paragraph in Fredlund's 1975 Final Report indicates that additional data will be forthcoming after a 1976 survey is completed,

e.g., results of testing at the Channel Rock Piles site, 24BH1525. Thus a complete archaeological statement is not yet available. However, it is my impression that a new archaeological survey of Decker lands would, in effect, duplicate effort and produce an inventory of cultural sites that was not significantly different from the final report now in hand.

Some things about the 1975 Final Report still bother me: I would have appreciated more explanation and justification for decisions that were made about testing and the relative importance of sites. But these are not points at issue.

Thank you for the opportunity to comment and for providing me with a copy of the 1975 Final Report.

Yours very truly,

A handwritten signature in cursive script, appearing to read "Dee C. Taylor".

Dee C. Taylor
Professor, Anthropology

tr

Department of Sociology
College of Letters and Science
and
Agricultural Experiment Station

Sociology Rural Sociology
Social Work Anthropology
 Criminal Justice

December 15, 1976

Brace Hayden, Environmental Coordinator
Department of State Lands
State of Montana
State Capitol
Helena, MT 59601

Dear Mr. Hayden:

On December 6 I received from you a request for professional advice. Your letter stated that your department was "primarily interested in the adequacy of the Fredlund's final report. Should a new archeological survey be made of the Decker land as Dr. Lahren and other critics suggest or is the final report sufficient?" Accompanying the request were the following:

- 1) a copy of the Fredlunds' research proposal to the Decker Coal Company for the East and North Decker lease areas;
- 2) a copy of a paper entitled "Archeological Resources of the West Decker Area - An Impact Appraisal" prepared for the Decker Coal Company by Western Interpretive Services;
- 3) a copy of the Fredlunds' final report entitled "The 1975 Archeological Survey and Testing of Decker Coal Company Lands, Big Horn County, Montana";
- 4) a copy of a letter by Dr. Larry Lahren criticizing the Fredlund study; and
- 5) a copy of a letter by Robert A. Murray of Western Interpretive Services defending the Fredlunds' study.

The standards of archaeological investigation are in a constant state of flux, with ever-increasing rigidity becoming necessary as we find ourselves embroiled in ethical and legal considerations. For this reason, the Fredlunds' report must be viewed at least partly in light of the time period during which the proposal for research was developed.

Information provided in the report indicates that 112 man-days were invested in the survey of approximately 11.5 sections, resulting in each individual surveying approximately 66 acres per day. If the time is well spent and the surveyors competent, this rate of survey is sufficient to provide extremely detailed knowledge about the archaeology of the area. In no instance, however, would I anticipate that all archaeological features would be discovered, as new

archaeological sites are constantly being exposed and old sites either destroyed or buried. Mr. Lahren purports to have discovered eight new prehistoric sites and one historic homestead site (neither descriptions nor locations provided) on land previously surveyed by the Fredlunds. This is entirely probable but need not reflect deleteriously upon the Fredlunds' competence or diligence.

In his letter supporting the Fredlunds, historian Robert A. Murray states that "efficient surveys, good sampling and effective systematization of data . . . constitutes an approach that is both more efficient and more productive of meaningful scientific results than total-collection of artifacts and data from extensive areas." The efficiency is unquestionable; the productivity of such approaches is more doubtful (If controls are the same, all the information is better than part.). It is probable that all archaeological surveys represent a sampling procedure. The problem is that of making the procedure both explicit and systematic. I should be able to determine from the Fredlunds' report where they did not see sites. In other words, what paths did the survey parties follow? Were a series of transects utilized? If so, what was the interval? Ten feet? One hundred feet? Did they follow natural ecological boundaries? Why? How? This information is not provided. Had the Fredlunds explicitly stated what pieces of terrain were covered and at what level of observation, we would be able to determine whether because of research design they did not cover the ground where Lahren found additional sites or if those sites were unobserved, an important consideration. For this reason, the systematics of the Fredlunds' survey are open to question. An additional problem is the absence of sub-surface testing in likely areas of sub-surface deposition. Most archaeologists have learned to predict the probable locations of buried sites on the basis of topographic and geological features. The use of a backhoe, coring machinery, or, more appropriately, shovel tests in a variety of localities would have added strength to the Fredlunds' conclusion that no further archaeological work is indicated.

Murray states, "It is always possible that additional buried sites might be encountered in any extensive surface disturbance such as this, but your plan takes this into account adequately for the present EIS, so far as we can see." From this statement, I assume that some program of monitoring of archaeological materials during land modification activities is intended.

The materials provided from all parties present problems which make a professional assessment impossible. Lahren's statement provides no documentation concerning either the significance or the location of new sites within the East and North Decker units. This information should be provided before his comments are taken under advisement. The final report by Lynn Berry Fredlund contains internal inadequacies which should be resolved:

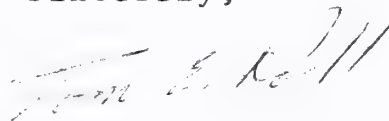
- 1) a precise, detailed statement of systematics utilized;
- 2) why sub-surface testing at appropriate depositional localities was not performed;

- 3) is continued archaeological work to occur;
- 4) whether monitoring of disturbance activities will or will not be carried out;
- 5) if monitoring, who? How?

As land modification activities will continue at an increasing rate within our state, it will become increasingly clear that precise criteria concerning archaeological sampling procedures will become essential. These criteria must be stated explicitly and followed to the letter. Obviously these criteria must be set down in a fashion appropriate for land managers.

The office of the State Historic Preservation Officer has engaged archaeologists for the purpose of reviewing environmental impact statements and other related matters. The present Historic Preservation Officer is Mr. Ron Holliday, with the State Fish and Game Department in Helena. I suggest that this and similar correspondence should be forwarded to that office for further review.

Sincerely,

A handwritten signature in dark ink, appearing to read "Tom E. Roll", with a stylized flourish at the end.

Tom E. Roll
Associate Professor
Anthropology



MONTANA HISTORICAL SOCIETY

225 NORTH ROBERTS STREET • (406) 449-2694 • HELENA, MONTANA 59601

February 4, 1977

Director,
U. S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir:

As the State Historic Preservation Officer I have been requested to comment upon the draft Environmental Impact Statement entitled: Proposed Plan of Mining and Reclamation, East Decker and North Extension, Decker Coal Company Big Horn County, Montana. Specifically, we have been asked to comment on the survey of historic and archeologic resources and we have limited our review to the material provided to us for those areas of concern.

Archeologic Sites

There are no sites currently listed on the National Register of Historic Places for the areas proposed for mining leases. As of this date there are no nominations in process for sites located within the proposed mining lease areas.

However, there are some differences of professional opinion within the state as to the probable eligibility of at least one site and that is found in T 9 S, R 40 E, Section 13. It has been recommended that that site be tested to determine eligibility for the National Register.

We understand that the above referenced site location is unlikely to have surface disturbance within the next 5 year period, with estimates running up to 8 years before activity occurs.

Given the number of sites that exist, and given the extent of mining activity, together with all of the related surface disturbance that is going to occur, there will be some impact upon archeologic resources in the referenced area. We do not know which sites, or how many, will be affected.

In view of the above we wish to make the following request.

1. We request that we be advised as early as is feasible, on an annual basis, of the specific areas to be disturbed relative to the annual mining permit.
2. We request that we be given the opportunity to test, or arrange for testing by other parties, of the sites which will apparently be impacted by activity in a given year.

We anticipate that within a matter of several years or less we will have the opportunity to resolve the matters of eligibility for the entire area in question and that thereafter the annual review would be unnecessary.

We submit that the above referenced procedure, used as an interim measure in this case, will both protect the archeologic resource, which is our first responsibility, and allow the involved agencies and parties to proceed with the matters at hand.

We acknowledge that the material provided to us to date indicates that the majority of sites identified are not of National Register significance, based on present information. Further testing may alter that condition.

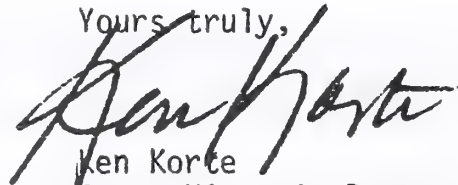
Historic Sites

There are no National Register sites on the property proposed for leasing. There are no sites currently in process of nomination for the Register on the referenced areas.

Based on information to date it does not appear that there will be any historic site of National Register significance on the referenced area. Should subsequent evidence be found to alter this condition, we will so advise.

Thank you for contacting us on this matter.

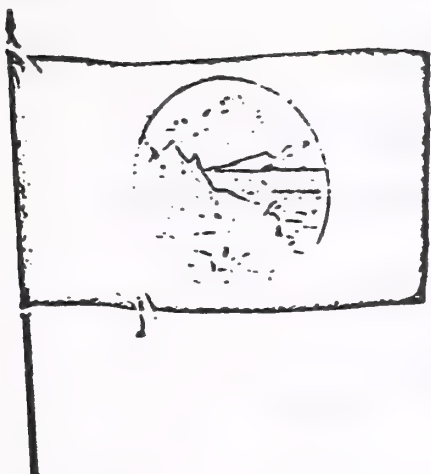
Yours truly,



Ken Korte
State Historic Preservation Officer

KK:AT:vk

CC: Montana Dept. of State Lands
Dr. D. Taylor, University of Montana
Advisory Council on Historic Preservation



THOMAS L JUDGE
GOVERNOR

STATE OF MONTANA
DEPARTMENT OF HIGHWAYS

HELENA, MONTANA 59601

H J ANDERSON
DIRECTOR OF HIGHWAYS

September 15, 1975

IN REPLY REFER TO

FAS 314
Decker North

Ashley C. Roberts, Administrator
Recreation and Parks Division
Montana Department of Fish and Game
Helena, Montana 59601

Dear Mr. Roberts:

The Montana Department of Highways is presently reviewing alignments for the relocation of FAS 314 proposed by the Decker Coal Company to accommodate anticipated expansion of their existing mining operations in Big Horn County Montana. At this time, we are considering two alignments as noted on the attached aerial photograph supplied by Decker. The dark pencil line represents Decker's proposed line and the red line represents an additional alternative the Department is considering as feasible.

We would appreciate your review of the project area to determine whether lands affected have present or planned 4(f) usage. In addition, a determination as to potential conflicts with historical or archaeological sites that may be in the process of nomination to the National Register and/or the State Historic Preservation Plan would be appreciated. Our prior review indicates no conflict. The Statewide Archaeological Survey has not been contacted regarding this potential project, however they will be furnished plans prior to any construction so that a field inspection can be made.

We are presently consulting with the Montana Department of Natural Resources concerning the relationships between relocation and the Tongue River Reservoir Recreation Area. If you desire additional information, please advise. We would appreciate the return of the attached aerial photo, as it is our only copy.

Very truly yours,

H. J. ANDERSON
DIRECTOR OF HIGHWAYS

By: *Stephen C. Kologi*
Stephen C. Kologi, P.E., Chief
Preconstruction Bureau

33-SCK:REH:dt
attachment

cc: D. S. Johnson
G. L. Anders
R. E. Hall
C. W. Klimper
Sharon M. Solomon
FHWA OS-30.22 B3

GEORGE VUCANOVICH CHAIRMAN
MONTANA

Wm M KESSNER Vice Chairman
D. S. J. S.

G R COONEY
D. S. J.

P L BACHELLER
D. S. J.

BARTER LARSEN
D. S. J.

STATE OF MONTANA



DEPARTMENT OF

FISH AND GAME

Helena, Montana 59601

October 3, 1975

RE: FAS 314

Decker North

Mr. Robert Hall
Chief
Environmental Unit
Department of Highways
Capital Station
Helena, Montana 59601

Dear Mr. Hall:

In reviewing the plans submitted to us for your Decker North Project, we find that there are innumerable archaeological sites in the vicinity. We urge you to proceed with the utmost caution when you reach the construction phase. The statewide archaeological survey at the University of Montana should be hired to assure that significant sites are preserved. No historic sites are known to exist in the close vicinity.

Sincerely,

Richard E. Mayer, Chief
Design and Development Bureau

Stephen C. Joppa

by: Stephen C. Joppa
Assistant Development Planner

RM:SCJ:jp
cc: Dave Conklin

| Date Recd. Preconst. 10/17/75 | | | | |
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| Act | Info | MAIL ROUTE | Attach | Initial |
| | | 30 | | |
| | | 31 Eng. Specifications | | |
| | | 32 Eng. Plans | | |
| | | 33 Road Design | | |
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| | | KIMPER | | |
| | | Title | | |

APPENDIX J

CORRESPONDENCE

DECKER COAL COMPANY

APPENDIX J

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CORRESPONDENCE REGARDING DECKER COAL COMPANY

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| Peter Kiewit Sons' Co. inter-office memorandum regarding soil monitoring in the Decker area. | J-2 |
| Peter Kiewit Sons' Co. memorandum regarding surface- water and ground-water monitoring in the Decker area. | J-3 |
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GENERAL OFFICE:
Sheridan, Wyoming 82801
P. O. Box 746

DECKER COAL COMPANY

P. O. BOX 746
SHERIDAN, WYOMING 82801

MINE OFFICE:
Decker, Montana 59025
P. O. Box 12

November 25, 1975

Address reply to: P.O. Box 746
Sheridan, WY

Mr. Norm King
U. S. Geological Survey
Federal Center Building 53
Lakewood, Colorado 80225

Dear Norm:

Enclosed please find several memos addressing the monitoring efforts in effect and proposed at the East and West Decker mines.

Regarding air quality, two high volume samplers are proposed for installation for monitoring of particulate matter. These high-volume samplers will be located so as to bracket both the East and West mine areas. In addition, monitoring instruments are being installed to record temperature, precipitation, wind speed and direction, relative humidity, barometric pressure, evaporation, and solar radiation. These instruments will be located near the rail loop at the West Decker mine.

I hope this information will satisfy your needs. If you have any further questions or need any clarification on this information, please call.

Sincerely,



Robert M. Clark
Environmental Coordinator

Encs.
RMC:ilf
cc: J. Reed

MEMORANDUM

Peter Kiewit Sons' Co. and Affiliated Companies

"Write It—Then We'll All Know"

Town Sheridan

Date 11-25-75

To Bob Clark

Phone _____

Re: Soil Monitoring

Regarding Norm King's inquiry as to any soil monitoring programs we may have:

1. We are presently involved in research contracts with MSU and USFS on reclamation at the Decker site. These both involve soil testing and monitoring of various sorts.

2. Our mining operation involves detailed soil analysis before, during, and after disturbance of any area. We test before stripping; we test what we have stockpiled; and we test after spreading and before revegetation. We probably will go back periodically and do analysis of soils from revegetated areas to watch for any changes.

I hope this brief explanation will give Mr. King some idea of the quantity of soil monitoring we are actually involved in.

EGR:dkd

From _____



E. Gary Robbins

M E M O R A N D U M

PETER KIEWIT SONS' CO., MINING DISTRICT

Sheridan, Wyoming

November 21, 1975

TO: Norm King
USGS
Denver, Colorado

FROM: M. C. Penz

Re: Hydrology of Decker area mining
sites

Surface Water

In the Decker area the company has established stream gauging stations on all major streams which pass through areas to be disturbed by mining. These stations consist of Parshal flumes equipped with Stevens F-2 stage recorders and backed up by USGS design crest gauges. The monitoring system consists of gauging stations located on the upstream and the downstream ends of the property. As the area is mined the downstream station will be reestablished at the discharge point of the diverted stream. These gauging stations will be maintained by the company until final bond release -- approximately five years after cessation of mine operations.


Water quality samples are collected at each of the stations during the spring high flow, during low flow, and for perennial and ephemeral streams a third sample is collected at an intermediate stage. The samples are analyzed according to the rules and regulations established by the State of Montana. Stage sediment sampling stations will be installed at the gauging station sites before the beginning of the 1976 spring runoff. These will be analyzed similar to the soil samples.

Ground Water

The company plans to drill three (3) monitor wells in the SW $\frac{1}{4}$ of Section 34 to test the ground water flow in the D-1 clinker. At least one of these wells plus the existing wells completed in the Tongue River, Deer Creek, and Spring Creek alluvium will be instrumented with Stevens F-2 stage recorders. In addition, at least one well completed in each of the coal beds will be maintained until the final bond release. The Montana Bureau of Mines and Geology has been studying the hydrogeology of the Decker mining area since 1970. We plan to have them continue

Norm King
Page 2
November 21, 1975

their study of the quality and quantity of ground water in the area. If they feel they cannot continue the study, the company will continue the program with their personnel. Samples have been collected at least once a year from wells completed in confined aquifers and twice a year from water table aquifers. These samples will be analyzed according to the rules and regulations established by the State of Montana.



M. C. Penz
Hydrogeologist

MCP:ilf
cc: T. Wollenzien
J. Reed

MEMORANDUM

Peter Kiewit Sons' Co. and Affiliated Companies

"Write It -- Then We'll All Know"

TOWN Sheridan

DATE 11-21-75

To Bob Clark

PHONE _____

RE: Decker Area EIS Team
Monitoring Design for
Vegetation

As you know, most of our activities have been confined to the gathering of baseline information, however, a long range monitoring feature was integrated into our baseline sampling design. We have placed on all properties in the Decker area numerous permanent transects for vegetation measuring. These transects were sampled for canopy coverage using a modified Daubenmire method analysis, (Recording data in square centimeters representations of actual canopy coverage) and also for standing crop by clipping ten $\frac{1}{10}$ acre plots per transect. Phytograms were prepared for some of the transects depicting clump intercept along the first one hundred feet of each transect sampled.

To complete the baseline information and start the monitoring program, I propose that phytograms be completed for all transects still undisturbed, and canopy coverage and standing crop information be gathered again to eliminate the biasing effect of our abnormally high rainfall this past season. With a two season floor of standing crop data, we'll be covered for even the most exacting scrutiny .

Thereafter, the less labor intensive procedures of canopy coverage measurement and phytogrametric comparisons will be re-established in approximately the same area as before disturbance. The first season of growth, the transects will be analysed for canopy coverage and a phytogram prepared. This will yield seedling establishment data. Phyto-social changes on the reclaimed surface could optionally be monitored by repeating these procedures yearly until release of the reclamation bond.

Standing crop sampling will be conducted during the two years prior to bond release to develop quantitative data on vegetative production (standing crop) for the state required comparison to pre-mining undisturbed sites.

DE:dkd

cc: Sam Scott

FROM DUFFY

Duffy Exon

M E M O

To: Bob Clark

From: Sam Scott

Date: November 20, 1975

Re: Wildlife Monitoring in the Decker Area

Bob:

In response to Norm King's request for information about wildlife monitoring, I'm listing work we are doing. More studies may be added in the future.

- I. Big Game (Mule deer, Antelope, White-tail deer)
 - A. Monthly aerial transects to determine:
 1. Population
 - a) census
 - b) structure
 - c) production
 2. Distribution
 - a) seasonal movements
 - b) movements in response to increased mining activity
 - c) movements in response to natural environmental changes
 - d) habitat use
 - B. Random Field Observations - measure same parameters as in aerial observations
 - C. Radio tagging of Mule deer - Daily telemetry reading of 30 deer in present mining area, East Decker, and CX Ranch areas.
 - D. Seasonal analysis of browse transects to determine use of major big game winter foods
- II. Small Game (Sagegrouse, Sharptail Grouse, Hungarian Partridge, Ring Neck Pheasant)
 - A. Random Field observations to determine:
 1. Populations
 - a) census
 - b) structure
 - c) production
 2. Distribution
 - a) seasonal movements
 - b) movements in response to increased mining related activity
 - c) movements in response to natural environmental changes
 - d) seasonal habitat use and requirements

Memo to Bob Clark
November 20, 1975
Page 2

- B. At least 3 times/week during mating activity check the use of strutting and dancing grounds in the area.
- C. Intensive studies to mark sage grouse and monitor their movements to define:
 - 1. Wintering areas
 - 2. Nesting areas
 - 3. Brood rearing areas
 - 4. Population structures

III. Small Mammals

- A. Monthly live trapping during appropriate seasons in 12 study areas to determine species diversity, density, production and home range requirements in Decker area
- B. Live trapping of reclaimed areas to determine same as above plus information on egress and ingress into reclaimed areas

Vegetation measurements are taken at same time so correlations can be made between small mammal populations and vegetation production.

IV. Non-game Birds

- A. Yearly monitor breeding-bird densities of natural habitat types and reclaimed sites in the Decker area.

V. Fisheries

- A. Baseline limnology study through 1976 - then monthly monitoring to detect changes in Tongue River Reservoir limnology
- B. Montana Fish and Game - yearly sampling of the game and non-game fisheries.

I believe this covers the major portion of the monitoring studies we are presently working on and plan to keep up. If you have any questions, pull my chain.

SJS:dkd

/dred

From

Sam

Sam Scott



DEPARTMENT OF STATE LANDS

STATE CAPITOL

HELENA 59601

(406) 449-2074

STATE BOARD OF
LAND COMMISSIONERSTHOMAS L. JUDGE
GOVERNORDOLORES COLBURG
SUP'T OF PUBLIC INSTRUCTIONFRANK MURRAY
SECRETARY OF STATEROBERT L. WOODAHL
ATTORNEY GENERALE. V. "SONNY" OMHOLT
AUDITOR

February 17, 1976

Decker Coal Company
P. O. Box 746
Sheridan, WY 82801

ATTENTION Jack Reed

RE: East Decker Application

Dear Jack:

This letter serves to firm up and clarify the discussion topics and positions expressed Wednesday, February 11, 1976, regarding the East Decker permit application. As you are aware, there are several components of the proposed mining and reclamation plan that are not acceptable.

I. The proposed mining plan calls for the mining of and spoilage into Deer Creek and its floodplain. This is unacceptable as proposed for the following reasons:

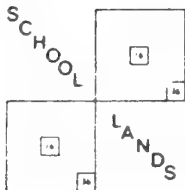
A. Section 9(50-1042) If the Department finds that the operation will constitute a hazard to a stream or lake, the Department shall delete those areas from the strip mining permit application before it can be approved.

B. The Deer Creek drainage does contain special values in terms of biological productivity and as critical in terms of ecological fragility and importance.

C. Mining or spoiling into Deer Creek would adversely affect the use, enjoyment or fundamental character of neighboring land (Tongue River Reservoir) having special, exceptional, critical or unique characteristics.

D. Section 10(50-1043) In developing a method of operation, all measures shall be taken to eliminate damages to landowners and members of the public, their real and personal property, streams and all other public property from soil erosion, water pollution and hazards dangerous to life and property.

II. The proposed plans call for construction of a loop and massive fill directly in the Deer Creek bay completely filling the mouth of this drainage except for a narrow channel around the north end. The loop location and massive fill into the mouth of Deer Creek are not acceptable.



A

RESOURCE

FOR THE
PRESENT

AN

OPPORTUNITY

FOR THE
FUTURE

February 17, 1976

A. The reasons stated under I. (A,B,C, and D) are applicable here as well.

B. The proposed fill would reduce the storage capacity of the reservoir by some 1,000 acre feet, which is about 1.7% of the total reservoir storage below the 3424.4 elevation, (DNR figures). This plan resulting in reservoir storage reduction would definitely adversely affect the use, enjoyment, and fundamental character of neighboring lands having special, exceptional, critical or unique characteristics.

III. The proposed plans for backfilling, regrading, contouring and reclamation involving creek entrances onto and across mining disturbance areas are not presently acceptable.

The reclaimed creek entrance and drainage area should be self sustaining, capable of handling flows that will not trigger soil erosion greater than the extent achieved prior to the operation and reclaimed consistent with the purposes of this act. The act does not allow the permitting of certain areas that either have special, unique, exceptional or critical qualities or would cause severe adverse reactions as a result of mining disturbances. If mining does proceed on delicately balanced areas, the reclamation plan must detail an acceptable and approved approach that would not trigger severe adverse reactions.

To accomplish the desirable objectives and avoid the adverse reactions as discussed above, the mining and reclamation plan should satisfactorily address backfilling of the final highwall and recontouring of the drainage routes through the mined disturbances. Stream gradients and locations should follow criteria outlined in the enclosed discussion by Jack Schmidt. The Department will review revised proposals for each affected drainage and approve only those proposals which meet the criteria outlined above.

The soils-spoils portion of the mining and reclamation plan will be discussed in detail at a later date. At present, as you know, the Reclamation Division does not have a Soil Scientist. Tentative thoughts, based on initial observations of our past Soil Scientist and outside professional comments, reflect the feeling that burial of the interburden should be required.

I believe that I have summarized the topics that were discussed at last week's meeting. If you have any questions please let me know.

Respectfully,

C. C. McCall

C. C. McCall, Administrator
Reclamation Division

jw

xc Commissioner Schwinden, Leo Berry, Brace Hayden, Dick Juntunen
and Steve Welch

APPENDIX K

CORRESPONDENCE REGARDING HIGHWAYS



APPENDIX K

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INTER-DEPARTMENTAL MEMORANDUM

DEPARTMENT OF HIGHWAYS

RECEIVED

JAN 12 1977

LT. GOVERNOR'S OFFICE

To Stephen C. Kologi, P.E., Chief-Preconstruction Bureau Date January 12, 1977
From Donald D. Anderson, P.E., Manager-Public Hearings Unit Subject FAS 13
Decker - North

The following is a resume' of the informal public meeting held in the Squirrel Creek School near Decker, Montana on December 14, 1976. Topic of discussion was the proposed relocation of a portion of Montana Secondary Highway No. 314 and the need for a separation structure at the railroad crossing just north of Decker on the same highway.

This meeting originated because of public comments made during the public hearings held on the Draft Environmental Impact Statement for the proposed plan of mining and reclamation of the Decker Coal Company.

Also, public input received by the Department indicated a problem concerning the railroad crossing approximately two miles northeast of Decker.

Those attending included:

Department of Highways;

Leslie Harris
Robert E. Hall

Donald D. Anderson
Jay Randall

Department of State Lands:

Brace Hayden

Decker Coal Company:

Jack Reed
Joe F. Faycosh
Frank Kinney

Big Horn County Commissioners:

John Lind
Edwin A. Miller

and some twenty-five landowners and/or concerned citizens of the area.

Following a brief introduction by the writer, Mr. Robert Hall described the relocation proposal and Mr. Harris explained the guidelines used in developing priorities for railroad crossing improvements in the state.

The testimony from the audience began with complaints of having to wait at the crossing for long periods of time before a train cleared. This would happen at least once a week. Mail route carrier has to use this crossing four times

To: Stephen C. Kologi, P.E.
From: Donald D. Anderson, P.E.

January 12, 1976

Page 2.

a day; school bus crosses six times a day. Sheridan, Wyoming, being the business center for the area, the majority of the people have to use this crossing to do their marketing, shopping, emergencies, doctors, high school activities, and entertainment.

It was suggested that the location of a new structure for the railroad crossing include consideration of the location of an approach to the county road extending easterly to Otter.

Flashing signals have been inoperative at times; should be advanced warning lights. One bad accident, many near misses.

A figure of 440 vehicles was given as the amount traveling to and from the coal mine.

Why isn't some of the coal tax monies being spent to improve the roads in the Decker area?

Who established priorities for road development in the coal areas?

The proposed relocation may be inundated if another dam were to be built on the Tongue River.

Those people living north of the realignment area objected to the additional mileage involved.

This secondary route serves as the major farm-to-market highway for a large area, almost from Busby south to Sheridan, Wyoming.

Written statements submitted included three letters from residents of the area supporting the need for a separation structure.



Donald D. Anderson, P.E., Manager
Public Hearings Unit

DDA:fc

cc: Jack R. Beckert
Paul R. DeVine
Charles W. Klimper

February 2, 1977

Dear Mr. Bacheller:

With expansion of mining operations in the area there will be a lot more traffic which has no other way to get to farming, ranching and mining areas.

School bus and any emergency vehicles such as fire, medical trips, etc., and also cattle and all produce to and from a large area must cross at this point.

BOARD OF COUNTY COMMISSIONERS
BIG HORN COUNTY, MONTANA

Ed A. Miller
Ed A. Miller, Chairman

John Besel
John Besel, Member

John Lind
John Lind, Member

DEPARTMENT OF HIGHWAYS

To Jack R. Beckert, Administrator, Engineering Division
From Paul R. DeVine, Chief, Planning and Research Bureau

Subject: FAS 314, Decker At Grade Crossing #BN98833W
Date December 29, 1976

A December 17, 1976 memo from Preconstruction requests our review and analysis of the existing at grade railroad crossing near Decker, Montana. We have completed our review and have the following comments and recommendations to make.

Existing Situation

1. At grade approach on BN Spur serving Decker coal mine.
2. Smallest angle of crossing is approximately $35^{\circ} 21'$.
3. Pavement plus shoulder width is 33 ft. with plank crossing.
4. Average daily vehicular traffic in 1976 = 440.
5. Average daily train movements are 10 which includes 5 pusher engines.
6. Crossing is protected by flashing light signals, pavement markings, and advance warning signs.
7. A train of 100 empty cars ordinarily occupies the crossing about 4 minutes, and a loaded train 7 minutes.
8. All coal is coming from the West Decker mine which is producing about 10 million tons per year.
9. Applying the existing factors to our hazard index formula we calculate an H.I. of 200 which warrants flashing lights.
10. There has been one known accident which involved a vehicle and a train.

Projections for Coal Mining

Coal mining in the Decker area is headed for large expansion according to mining plans submitted to the State Land Board. By 1982, Decker Coal Co. plans to double its production to 19 million tons per year by developing the East Decker and North Decker mines. Also Pacific Power and Light has submitted a mining plan to develop an open pit coal mine north of the Decker mine which is expected to produce 10 million tons annually.

| | 1976 Coal Production | 1976 Work Force | 1982 Coal Production | 1982 Work Force |
|-----------------------|----------------------------|-----------------------|----------------------------|-----------------------|
| West Decker | 10 million tons | 280 | 10 million tons | 280 |
| East Decker | 0 | 0 | 6.7 million tons | 270 |
| North Decker | 0 | 0 | 2.3 million tons | 70 |
| Pacific Power & Light | 0 | 0 | 10 million tons | 280 |
| TOTAL | 10 million tons | 280 | 29.0 million tons | 900 |

Beyond the above plans, consideration is being given to constructing a higher Tongue River Dam, and another coal mine near Birney by Wesco Incorporated. These plans probably will not mature for at least 10 years, but will have an impact on FAS 314 when it does.

Needs Based on Projected Traffic

The present work force of 280 is resulting in an ADT on FAS 314 of about 390 per day, plus about 50 per day of other local traffic for a total ADT in 1976 of 440.

By simple proportion we estimate the 1982 work force of 900 will result in an ADT of 1,250 + 50 locals or 1,300 per day.

Present production of 10 million tons per year requires the crossing to be occupied 10 times per day by trains. The West and North Decker mines plus the Pacific Power and Light mine production, will be transported by rail across the existing FAS 314 at grade crossing. The total tonage from these 3 mines will be about 22.3 million tons annually, requiring the crossing to be occupied 22 times per day. Using future volumes of 1,300 vehicles, 22 trains and "F" factors of 5.0 we arrive at an H.I. of 1,430.

Additional Factors

According to State guidelines an H.I. of 1,430 warrants flashing lights with gates. However the Decker crossing has other influencing factors which lend considerable weight toward warranting a grade separation.

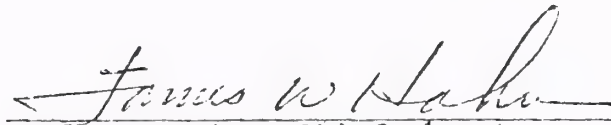
1. Secondary Route 314 is the only highway in the area. It provides access for the entire Birney, Decker, Kirby and other communities, to travel to Sheridan, Wyoming where they must go to receive medical aid, all necessities of life, mail, marketing, high school, fire protection, and social life. The populus lives north of the Decker railroad crossing and must by necessity cross the tracks to travel to Sheridan.
2. At a recent public meeting, the 25 people in attendance stated the crossing is blocked an average of once a week for a period of 20 to 30 minutes by the 100 unit trains.
3. Fire protection must come from south of the railroad crossing and could experience a long delay if a train happened to be at the crossing while going to a fire.
4. FAS 314 is a mail route which originates in Sheridan and must cross the tracks 2 times per day, five days per week.
5. The school bus is housed south of the tracks. It hauls high school children to Sheridan and elementary students to Decker. It crosses the railroad track 6 times per day. Locals state the bus is late for school once a week because of the train delay.
6. Marketing of livestock requires crossing the tracks with large loads of stock. Time delays at the crossing have an effect on the animals according to the stockmen.
7. Ambulance service must come from Sheridan to serve the area, requiring crossing the track twice on each trip. Untimely delays at the crossing could result in loss of life.
8. The down grade of the highway approaching the crossing from the south is about -4% which is dangerous, when icy, according to resident users.

Recommendations

The Decker railroad crossing is unique in that the entire work force plus all

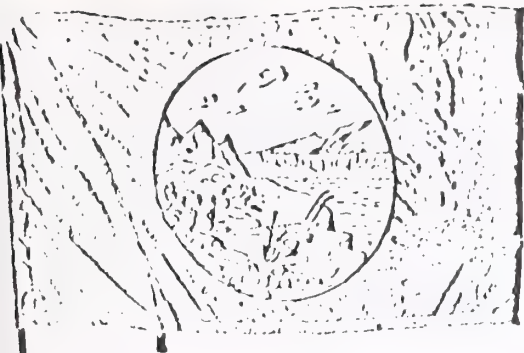
residents of this area must cross the tracks to commute to Sheridan, Wyoming. There is no mine town developing in Montana near the mines and it appears Sheridan, Wyoming will continue to be the primary living quarters and trade center for the southern part of Big Horn County, Montana. Proposed coal mining developments will create more and more conflicts at the Decker at grade crossing. Compared to other grade crossings in the coal development area, this crossing is receiving the greatest impact because of coal train movements.

We therefore recommend that a grade separation be constructed in the very near future at the Decker crossing. A 23' 7" span X 28' rise corrugated steel pipe could be installed at the present location to provide a tunnel for trains to pass under the highway, or a vehicular underpass appears to be feasible approximately 500 feet north of the existing at grade crossing without altering the railroad grade.



Paul R. DeVine, Chief
Planning and Research Bureau

PRD:LSH:cv
cc: Steve Kologi
Dave Johnson
R. Hall
D. Anderson



STATE OF MONTANA
DEPARTMENT OF HIGHWAYS

HELENA, MONTANA 59601

May 10, 1976

H. J. ANDERSON
DIRECTOR OF HIGHWAYS

IN REPLY REFER TO
0026:PRD

Mr. D. Peinovich
Director, Engineering
Burlington Northern Inc.
2224 Montana Avenue
Billings, Montana 59101

Dear Mr. Peinovich:

We would appreciate information concerning the Burlington Northern trackage entering from Wyoming and ending at Decker in Big Horn County. Our concern is the grade crossing on Secondary 314 northeast of Decker, Id. No. 98833W, now protected by flashing lights.

Please advise us of the present train ADT and the future intentions of Burlington Northern regarding possible increased train volumes and trackage at this crossing site.

Also, if there is train operation at the crossing which creates highway blockage and if so for how long of time.

Attached is a copy of a petition signed by 171, received by the Department of Highways. Your comments on this petition would be appreciated.

Thank you for any information you can give us.

Very truly yours,

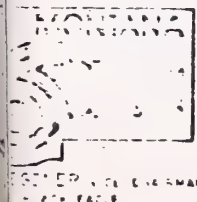
H.J. ANDERSON
Director of Highways

By _____
Paul R. DeVine, Chief
Planning and Research Bureau

PRD:LSH:DM:cv
Attachment
cc: Utility Unit

K-9

GEORGE VUCANOVICH CHAIRMAN
HELENA



P. L. BACHELLER
BILLINGS

G. R. COONEY
RUTTE

BAXTER LARSON
WOLF POINT

ENGINEERING DEPARTMENT

2224 Montana Avenue
Billings, Montana 59101
Telephone (406) 259-4521

Mr. H. J. Anderson
Director of Highways
State of Montana
Department of Highways
Helena, Montana 59601

September 9, 1976

Attention: Mr. Paul R. DeVine
Chief, Planning & Research Bureau

Your File: 0026:PRD

Dear Mr. DeVine:

Please refer to your letter of May 10, 1976, pertaining to the grade crossing at Secondary 314, Crossing Number BN 98 833W, near Decker, Montana.

The average number of trains passing over this crossing is 5 per 24-hour period, plus approximately 5 daily moves with helper locomotives. Present projections indicate that by 1980, rail traffic will increase to 8 trains per 24-hour period, plus 8 daily moves with helper locomotives.

It is possible that an additional mine or mines will be opened in the Decker area in the future in which event additional rail traffic over the crossing could take place. Whether or not this would involve another track through the highway is unknown at this time.

Under normal circumstances, we do not stop trains on the crossing. A train of empties ordinarily occupies the crossing about 4 minutes, and a loaded train 7 minutes.

We hope the information above will be of assistance to you.

Sincerely,

D. Peinovich
D. Peinovich
Director Engineering

AB/bh4

cc: Mr. C. J. Bryan
Mr. E. M. Martin
Mr. W. J. Costle

File: Decker - 1

K-10



STATE

OF WYOMING

HELENA, MONTANA

MONTANA HIGHWAY COMMISSION

RECEIVED

JAN 12

Wyoming State Highway Department

P. O. BOX 1708

CHEYENNE, WYOMING 82001

January 6, 1977

RECEIVED

JAN 25 1977

Mr. Stephen C. Kologi
Chief, Preconstruction Bureau
Montana Department of Highways
Helena, Montana 59601

LT. GOVERNOR'S OFFICE

Dear Mr. Kologi:

We have reviewed the information submitted in your letter of December 17, 1976, concerning the expansion of coal mining in the Decker area; more specifically, the crossing of Wyoming Highway 336 by the Decker Coal Company's railroad spur line near Wyarno. The information provided is very sketchy; consequently, our remarks will be based on several assumptions concerning the rail operation.

Present Conditions

The Decker spur line joins the main line of the Burlington-Northern Railroad approximately 3 miles northwest of Wyarno. At this junction, the main line lies to the south of Highway 336 and Decker lies to the north. There is a "we" connection between the two rail lines, and Highway 336 crosses both legs of the "we".

Both crossings are protected with automatic electric flashing lights and bells, advance warning signs, pavement markings, and floodlights for night illumination. A hazard inventory conducted in 1973 showed there were 4 trains per day and an average daily highway traffic of 290 vehicles. This, and other site data, were evaluated through our hazard rating formula. The resulting hazard rating was very low, and ranked these two crossings in the lowest one-third of all the crossings on our Federal-aid Secondary System.

For the most ideal conditions, the simplest criteria for establishing warrants for a grade separated crossing is the Exposure Factor. The Exposure Factor is the product of the annual average daily traffic and the greatest number of trains per day. Warrants for a grade separation exist when this factor exceeds 25000. The criteria would indicate that with the potential 20 trains per day, warrants for a grade separation would not exist until traffic on Highway 336 increased 3 to 4 times.

However, ideal conditions are not inherent with this crossing; and, in large measure, whether warrants for a separation exist hinge on analysis of factors which can only be evaluated subjectively. And complicating this analysis is the scarcity of train operational data.

Complicating Factors and Assumptions

Highway 336 is the only road between Sheridan and the Wymarno area. It serves as a mail route, school bus route, and as a route for police and fire protection as well as medical and emergency services. And, according to the hearing testimony, it also serves as a stock driveway.

Highway 336 crosses both legs of the railroad "we", which are on curves. Since this is the junction with the Burlington-Northern main line, railroad operating speeds will be reduced--assume to 10 mph.

According to the Eastern Powder River Coal Basin of Wyoming Final Environmental Impact Statement, unit coal trains can vary from 40 to 300 cars. We assume an average of 110 cars which is roughly 1.2 miles long.

There is a potential of 70 loaded trains per week. We assume uniform traffic of 20 trains per day.

Conclusions

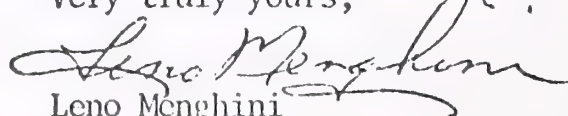
Based on these assumptions, one 110 car train would block the crossing approximately 8 minutes; twenty trains would block the crossing 2 hours and 40 minutes per day, or 11% of the time. Erratic train scheduling could cause prolonged crossing blockage. Conversely, trains could be scheduled during periods of little highway traffic.

The Wyoming State Highway Department must spend its railroad crossing protection funds in a prudent and judicious manner. We have a continuing program of monitoring railroad crossings, and when the hazard rating of a particular crossing becomes high enough to rank the crossing near the top of the list, the crossing is analyzed for improvement. Crossings that are selected for upgrading are ones with high hazard ratings and ones that will benefit the most people. In this respect, it does not now appear that the Wymarno crossing would be accorded a high priority in the near future.

There are extenuating circumstances associated with the Wymarno crossing which may warrant a separated crossing when the number of unit trains approach the potential 20 per day, or if there is a significant increase in traffic on Highway 336.

While the Department has no written policy that applies to the Wymarno situation, we firmly believe that the coal companies and the railroad have a responsibility to operate this spur line in a manner that will not cause unreasonable hazards or unreasonable inconvenience to the local residents; especially so when the hazards and inconvenience can be largely attributed to coal company and railroad operations.

Very truly yours,



K-12 Leno Menghini
Superintendent and Chief Engineer

HELENA, MONTANA 59601

H J ANDERSON
DIRECTOR OF HIGHWAYS

March 3, 1977

IN REPLY REFER TO

Decker EIS
FAS 314

Mr. Leo Berry, Jr., Commissioner,
Montana Department of State Lands
Capitol Station
Helena, Montana 59601

Dear Mr. Berry:

As per an agreement reached with your agency (your letter of December 6, 1976) Mssrs. Johnson, Hall, Anderson, and Williams met with your Mssrs. McCall and Hayden on January 28, 1977 to discuss the possible alternate alignments of the Decker Coal Company's proposal to relocate Federal-Aid Secondary 314 in Big Horn County, Montana.

As you may recall, the Department of Highways analysis of transportation system impacts for the subject environmental impact statement discussed a diagonal alignment across the mined out area as a viable alternate. Briefly, under that alternative mining would proceed westward until abutting the statutory buffer distance of the existing FAS 314 alignment. Interline traffic and coal hauling equipment would cross through an underpass (constructed by the applicant) with FAS 314 passing over. During advancement westward toward the present road the applicant would construct an alignment in the mined-over area as part of their reclamation effort. This new "diagonal" alignment would be complete, with the possible exception of a temporary connection at the northerly end, at that time when the applicant desired to close the present road to through traffic and re-route on the new section.

In addition to the costs and benefits noted in the draft impact statement, discussions of January 28th revealed that

front end costs to the applicant would be less, the option to move to the "west shore" alignment would still be available at a later date, and the local desires as to an alignment with the least possible mileage (as expressed at public meetings and hearings) would be achieved, if a diagonal alignment was pursued. Your personnel agreed that as far as the Decker proposal is concerned, a diagonal alternate would be in the best public interest.

This correspondence serves as a confirmation of that agreement and notice of our Department's intention to vigorously pursue the same, even though some inconveniences and changes may be required in the applicant's permitted mining plan.

As of this date, the Department of Highways has not officially received through the proper and necessary channels a relocation request from the Decker Coal Company. In order to avoid unnecessary delay it would be advisable to see that your mining permit and our intention regarding the relocation are consistent, and that Decker be advised of this action.


Your comments would be appreciated.

33-JRB/MJD/js

cc: S. C. Kologi
D. S. Johnson
M. J. DaSilva
D. D. Anderson
K. F. Skoog
P. R. DeVine
R. E. Hall
C. W. Klimper

Very truly yours,

H. J. ANDERSON
DIRECTOR OF HIGHWAYS

By 
J. R. Beckert, P. E., Administrator
Engineering Division

APPENDIX L

MASTER RECREATIONAL DEVELOPMENT PLAN
FOR THE
TONGUE RIVER RESERVOIR

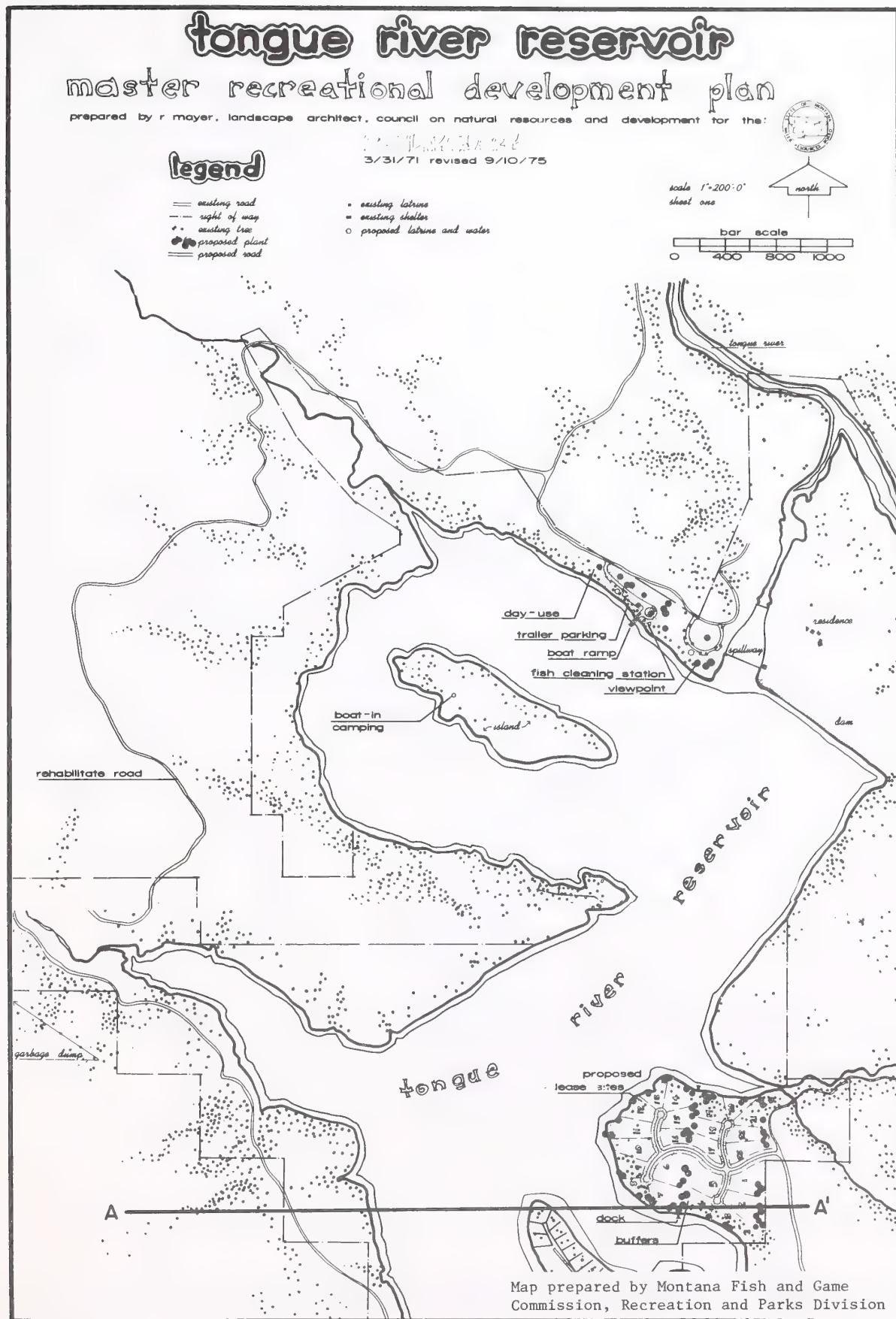


Figure K-1.- Preliminary master recreation development plan for the Tongue River Reservoir (see fig. K-1A for adjacent reservoir area to the south; maps join along match line A-A').

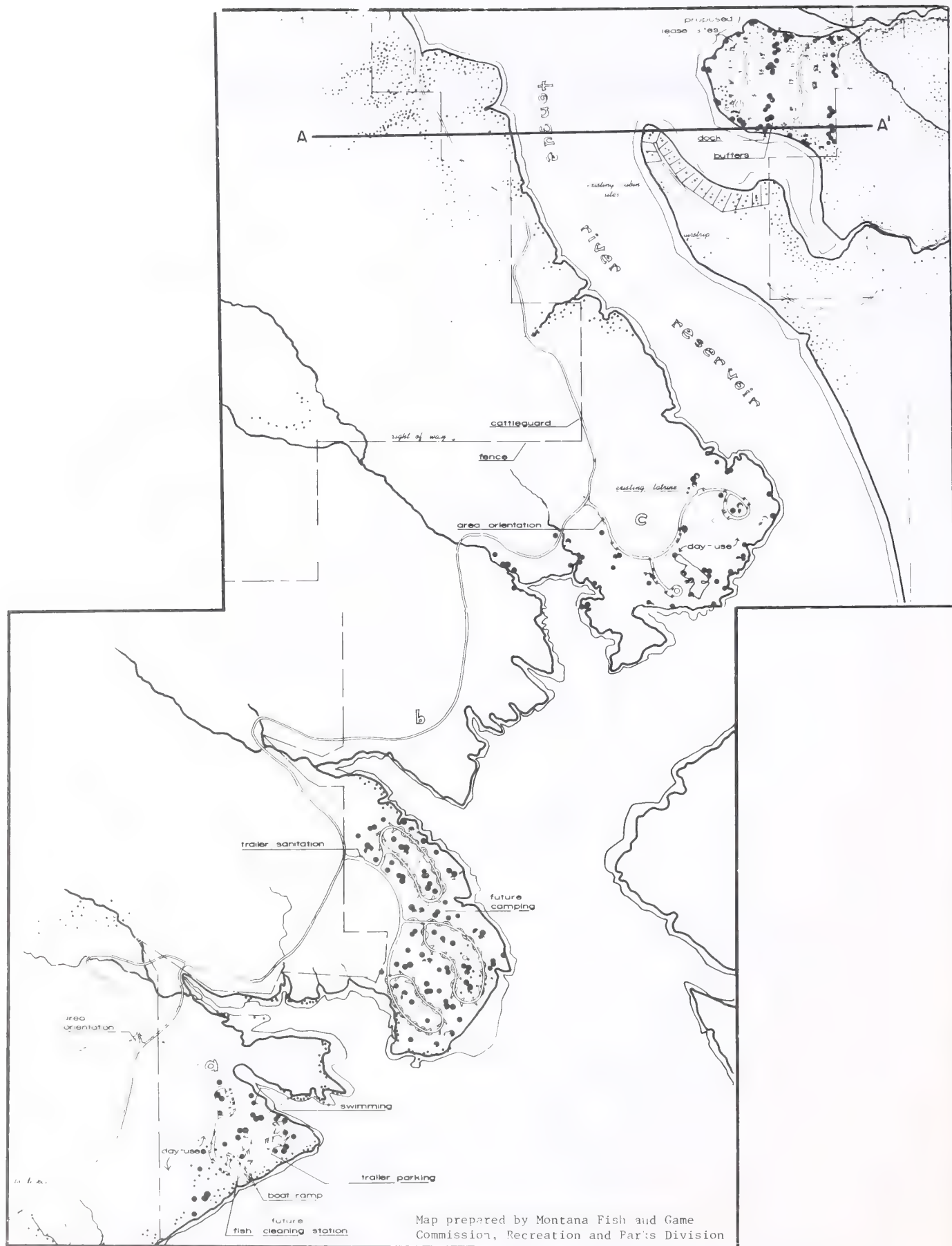


Figure K-1A. — Preliminary master recreation development plan for the Tongue River Reservoir (see fig. K-1 for adjacent reservoir area to the north; maps join along match line A-A').

APPENDIX M

WRITTEN COMMENTS AND RESPONSES
ON THE
DRAFT ENVIRONMENTAL STATEMENT

APPENDIX M

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ON THE
DRAFT ENVIRONMENTAL STATEMENT

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LETTER 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80203

DEC 14 1976

Ref: 8M-EE
D-IGS-J01008-MT

Mr. Henry W. Coeller
Acting Director
National Center
U.S. Geological Survey
Mail Stop 108
Reston, Virginia 22092

Dear Mr. Coeller:

We have reviewed the draft environmental impact statement (EIS) on the Proposed Plan of Mining and Reclamation for East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana.

First, we would like to commend you, your staff, the State of Montana, and others involved in the effort reflected in this draft EIS. In our opinion, the "Decker" impact statement is much improved over previous mining plan/EIS's.

Our major concerns with this draft EIS and the action it proposes are that, first, the majority of the analysis has been directed at two mining plans that probably are unacceptable to the State and do not meet Federal requirements. It is our understanding that the East Decker plan is not acceptable to the State because of proposed spoiling into Deer Creek. At the same time, because it would not assure the necessary removal of the coal resource, we do not believe that the North Extension plan meets Federal regulations.

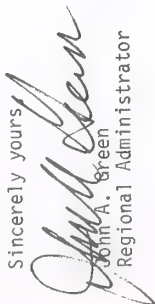
Because of this probability that the two alternatives that have received the bulk of the impact analysis are not acceptable, we believe that the alternatives (B-3 for example) that are more likely to be approved should be given more extensive analysis. Without this needed information, we do not believe that the mining plan/EIS meets Federal strip mining regulations.

EPA detailed comments are listed in the addendum included with this letter. According to the EPA rating system for draft environmental impact state-

ments, this document and the action it describes has been rated as ER-2 (environmental reservations -- lack of sufficient information).

If you have questions on these comments, please contact this office. We hope to be able to work with you for the resolution of issues involving this project.

Sincerely yours,



John A. Green
Regional Administrator

EPA Detailed Comments On The Draft
Environmental Impact Statement On
The Proposed Plan of Mining And
Reclamation For East Decker And
North Extension Mines, Decker Coal
Company, Big Horn County, Montana

1. This draft environmental impact statement analyzes, as the major action, approval of two mining plans, East Decker and North Extension Mines, neither of which may be approved. In the case of the East Decker plan it is our understanding that the State of Montana would not allow the proposed action because it would result in the spoiling of Deer Creek. In the case of the North Extension plan, we do not believe that it can be approved by the Federal government because it does not provide for adequate removal of the coal resource.

2. In our opinion, the draft EIS and the mining plans submitted by the applicant do not contain adequate information on which to judge whether such mining can be permitted under the currently applicable elements of Part 211 of Title 30, CFR. If the major actions given the bulk of the impact analysis in the EIS cannot be approved, then other alternatives, as listed in the EIS, which are more likely candidates for approval should be given adequate analysis. An adequate analysis of these more probable alternatives has not been done.

EPA does not wish to conclude that any EIS is premature, but it is unfortunate that the mining plans that stand the best chance of being approved have not been analyzed as completely as have the initial plans. We recommend that the USGS consider an amendment or supplement to this draft which would correct this deficiency. We do not intend that any work be duplicated, but do believe that some type supplement, also in draft form, be made available for review before the final EIS stage and its final recommendations are reached. Again, we believe that it is necessary that sufficient information be submitted to permit the Geological Survey to judge whether reclamation of the affected land to the standards set forth in 30 CFR 211 is attainable and assured.

3. As stated, we consider the mining sequence analyzed for North Decker to be inappropriate from the standpoint of isolating additional coal reserves from future recovery. The alternate mining plan for the North Extension provides for resource recovery but would appear to fail under the amended section 203 of 30 U.S.C. -- a situation not discussed in the draft EIS. A lease adjustment should likely address adoption of a royalty of 12.5 percent of the value of the coal unless 30 U.S.C. is considered to eliminate the need to assess the lease stipulations.

1A

The objections raised by the Montana Department of State Lands to spoiling into Deer Creek valley and to several other aspects of the proposed mining plan for the East Decker area together with the reasons for those objections are stated on p. 696-697. As a result, the Decker Coal Co. has submitted an alternate mining plan for appraisal that it believes would alleviate the objectionable aspects of the original proposal. Alternate Plan B is described on page 696-731. It should be noted, however, that the Company has not withdrawn the original proposal from further consideration by the Montana Department of State Lands or the Area Mining Supervisor of the U.S. Geological Survey and no action has been taken on that proposal by either agency.

1B

In the case of the proposed North Extension mining plan, it should be noted that the Decker Coal Co. holds valid coal leases for all lands included in their original proposal. As such, the Company has an exclusive right to mine the lands described in their existing leases, subject to Federal and State approval of the mining and reclamation plans and the administrative alternatives described in sections VIII. B. and C. Should the Company not obtain a lease for the additional coal resources in sections 3 and 34 for any reason, they retain the full right to develop their existing leaseholds in the North Extension area.

Accordingly, the proposed mining plans described in section I for both the East Decker and North Extension areas are the proposed Federal and State actions and must be described in detail in the FES.

2A

The proposed Alternate Mining Plan B for the East Decker Area and the alternate mining plan for the North Extension area have been reviewed by the Area Mining Supervisor for compliance with the requirements of 30 C.F.R. 211.10(c), and he has found that both plans meet those requirements. The appraisal of Plan B has been expanded from 9 pages and 3 illustrations in the DES to 76 pages and 8 illustrations in the FES. The analysis of Alternate Plan B for the East Decker area and the alternate mining plan for the North Extension area as presented in the FES have been reviewed by the Area Mining Supervisor and by the Montana Department of State Lands for completeness, and both plans were found to have been treated adequately. Proposed Alternate Mining Plan A for the East Decker area does not involve the mining of any federally-owned coal, and therefore, no approval by the Area Mining Supervisor is required. Approval by the Montana Department of State Lands would be necessary, however, before plan A could be implemented.

4. In Montana, It has been proposed that 211.40(a)(7) be replaced with requirements that all drainage from an active mine area meet water quality standards of pH(6.0 - 9.0), iron (7 mg/l), and produce only a certain increase in turbidity (10 J.C.U.).

The draft EIS identifies numerous uncertainties regarding the ability of the planned activities to meet this performance standard (pp 493 et seq.). These uncertainties are compounded by the need to revise the mining plan addressed in the body of the report in accord with plan B-3 to avoid spoiling into sensitive areas and to better achieve approximate original contour.

For example, on page 498 it is indicated that slope reductions to 10% (1:10) would enhance vegetative growth and limit erosion. Also mentioned is contour furrowing. The applicant's proposal makes no mention of achieving 1:10 slopes over the entire area nor of surface manipulation procedures. If, in fact, the post-mining land use is to be grazing, we would suggest the better topography would be that where all slopes were 10%. The temporary dikes noted on page 498 should be required.

5. Aquifer replacement (p 500) is no longer as simplified if alternate mining plan B-3 is employed. This would be the case since dragline spoils are not produced in plan B-3.

6. Sedimentation ponds, discussed in pages 501 through 511, appear to be proposed in varying sizes. The EIS recognizes the likely inaccuracy of the initial estimates of inflow (East Decker 0.2 cfs; North Decker 0.1 cfs), the likely error in calculating the revised inflow rates (apparent rates) submitted on December 1, 1975, (East Decker 23 cfs; North Decker 180 cfs), and the DOI initial estimates which lay in between (East Decker 2-2.8 cfs after one year; North Decker 7.8 - 10.4 cfs). However, no resolution of the differences is proposed and Alternate Mining Plan B-3, the plan likely acceptable from the standpoint of post-mining topography near Deer Creek, does not include an equivalent plan for sedimentation/water quality treatment facilities.

7. The December 1, 1975, plan submitted by Decker Coal Company has been analyzed by DOI as reducing the inflow from the reservoir and thus reducing inflow from the 2-2.8 cfs to 0.7 cfs at East Decker and from the estimated 7.8-10.4 cfs to 5.4 - 8.7 cfs at North Decker. If the ground water barriers remain after mining and are overtopped by ground water flow, we are interested in the results of stability analyses of the more permeable material as saturation and flow take place. While breaching alternatives are noted (p 510), the effects are not presented.

One of the objectives of an EIS is to identify and evaluate feasible alternatives to the proposed action. This does not mean that identified alternatives need to be discussed in the same amount of detail as the action being proposed. In the present matter, the project areas in both the East Decker and North Extension proposals are the same under the original and alternate mining plans. One alternate plan differs only with respect to the mining method to be employed. Analysis of a second alternate plan (Alternate Mining Plan B-3) for the East Decker area has been expanded considerably in the FES (refer to pages 696-772). Since (1) no significant additional impacts are identified in the expanded analysis in the FES, and (2) the expanded analysis will be available for review in the FES, the Montana Department of State Lands and the U. S. Geological Survey do not perceive a need to circulate that analysis for review as a supplement to the draft EIS.

No final recommendations as to alternatives are presented in the FES. Alternatives are presented that could be adopted by the decision-makers if they so decide. The material presented in the FES is not intended to restrict a decision-maker's option to select one of the alternatives to the proposed action or to require modification of the proposal (see text revisions p. 509).

As stated in the response to comment 1 above, the approval of the proposed mining plan for the North Extension area is not dependent on the recovery by the Decker Coal Co. of additional unleased federally-owned coal resources in adjacent sections 3 and 34. Should Decker Coal Co. be the successful bidder in the competitive coal lease sale tentatively to be held by the BLM in May 1977, these coal resources could be recovered under the alternate mining plan for the North Extension area, if approved. Terms of any lease issued would conform to section 203 of 30 U.S.C. and would provide for a royalty of 12.5 percent of the coal mined in sections 3 and 34.

The change in regulations referred to has not advanced beyond the proposal stage. It should be noted, however, that effluent from the West Decker mine would meet all the water-quality standards proposed (see Van Voast and Hedges, 1975, table 6). Prospects are very good that effluent from the proposed mines under both the original and all alternate plans would also meet those standards.

8. Of particular concern is the operational and post-operational stability of surface drainage channels at both East and North Decker. We feel the draft EIS provides an excellent analysis of the fluvial and other geomorphologic processes existent in such climates. It appears to make little sense, however, to analyze diversions and realignments proposed for the principal mining plan when the alternative mining plan (B-3) is likely required. Since no post-mining topography plan is provided for alternative plan B-3, we are not able to assess the post-mining stability of stream channels. It is certainly our hope that a post-mining drainage pattern similar to that shown on page 34 (Figure 9) will not be approved. The draft EIS notes that the Deer Creek or, for that matter, any similar diversion would fail over time. No provisions have been made to maintain sedimentation ponds in the surface drainage network. We are seriously concerned that no data exist to indicate that drainage over highwalls with 1:5 slopes is acceptable for post-mining periods when water quality maintenance of sedimentation ponds has ceased. The semi-quantitative analyses of erosion and deposition presented in pages 328-331 is excellent but provides no data to support the apparent hypothesis that a suitable geomorphic equilibrium will be reached. We would be pleased also to review data that support the use of a roughness coefficient of 0.03 for grassed channels.

9. We agree with the following quotation (p 331) from the draft EIS.

"Because of the many uncertainties associated with the final design, construction, performance and maintenance of the proposed diversion system in the East Decker area, the outcome of the reclamation plan, and the unpredictability of runoff events during the life of the proposed operation, any appraisal of the effect of the proposed mining plan on the sediment yield to the Tongue River Reservoir is necessarily more qualitative than quantitative in nature."

10. Many of the additional mitigating measures, listed on pages 516 through 526, appear to have merit and should be required of the operator. However, one must distinguish between mitigating measures appropriate for temporary diversions and impoundment and mitigating measures for permanent post-mining drainages. For example, concrete drop structures are likely not long-term control procedures since they would require maintenance. Specifically, mitigating measures listed on pages 524-6 should be incorporated in the plan of operations.

11. We must question whether the post-mining topography shown for the alternate mining plan for the North Extension is in compliance with

The decision-maker may attach appropriate stipulations to the approved mining permit that would require slope reductions to 10% or less to promote slope stability (p. 527, 533) and surface manipulation procedures (p. 533) that would reduce the potential for long-term erosion, or he could require adoption of an alternate plan (Alternate Plan B) in the East Decker area to avoid spoiling into Deer Creek valley and to achieve approximate original contour. In the absence of those measures, however, a long-term reduction in sediment yield to the Tongue River Reservoir is expected under the proposed mining plans and the alternate mining plans, provided that valley trenching is prevented upstream from the highwall. The Decker Coal Co. has stated that they will take all appropriate measures to prevent erosion at the highwall and to construct stable channels across the reclaimed mined areas. Also, the Montana Department of State Lands would require that appropriate stipulations be attached to the permits to assure reconstruction of stable channels after mining is completed. It is doubtful, therefore, that streams traversing the project areas would show any increased turbidity after mining and reclamation is completed.

The option of requiring slope reductions to 10% or less, surface manipulation procedures, and temporary dikes to control erosion are available for consideration by the decision-maker as he reviews the record.

Aquifer replacement under Alternate Mining Plan B-3 for the East Decker area (Plan B in the FES) should not differ significantly from that in the proposed plan. Figure 78 shows that the lower part of the spoil materials would be laid by dragline. These spoils in turn would be covered by truck-laid materials. Thus, the base of the spoils, where greatest permeability is expected to occur, should be equally permeable in both the original and the alternate plans. In all probability, the overlying truck-laid spoils would be less permeable than the drag-line laid spoils; however, they would be relatively uncompacted and should be far more permeable than scraper-laid spoils. Thus, the replaced aquifer under Plan B-3, like that under the proposed plan, very probably would have a higher hydraulic conductivity and porosity than the undisturbed parent rock in the mined interval.

See text revision (p. 546).

The discussion of Alternate Mine Plan B for the East Decker area has been expanded to include a discussion of sedimentation/water-quality treatment facilities (p. 714-722 and 728-730, figs. 81 and 82).

11 performance standard 211.40(a)(2) without applying for a variance pursuant to 30 CFR 211.74 (considering the proposed revision in 211.40(a)(2) contained in FR 41-165-35716; August 24, 1976).

12 12. A question exists as to the amount of coal recovered in each of the planned operations and the amount of the coal resource available. Information submitted with the mining plan(s) appears to show a great deal of D-2 left in the ground over the leasehold. In what manner has the potential loss of this coal been assessed, especially in the context of 30 CFR 211.4(b), i.e., to insure extraction, to the maximum extent possible, of the coal resource and to minimize future disturbance of the environment through resumption of mining? See also 211.10(c)(6)(XV).

13 13. We are supportive of the alternate mining plan for the North extension area in that it recovers coal reserves in sections 3 and 34. However, lease term adjustments under 304.S.C. 203 appear appropriate.

14 14. Title 30 CFR Subpart 211.1(b) states the purpose of the regulations is to assure orderly and efficient... operations and practices and, among other objectives, to minimize insofar as practicable, the "adverse social, economic and environmental effects." We are extremely concerned that the draft EIS has not identified mechanisms to be used to resolve the social and economic inequities that exist as a result of the revenues accruing to Montana and the support (housing services and other services) required of the Sheridan, Wyoming area.

15 15. While it is true that the Area Mining Supervisor of the USGS is to inspect leased lands on at least a quarterly basis (30 CFR 211.3(c)(1)), such inspections in the past have not involved assessment of the adequacy of operations in terms of environmental impacts -- that responsibility has been carried out by the State of Montana. It is necessary, to assess the adequacy of future inspection and enforcement actions at East and North Decker, to know the resolution of discussions carried out pursuant to 30 CFR 211.75(b).

17 17. What criteria are used for mulching and irrigating?

18 18. Table B3. What were the total concentrations of lead in the overburden samples? Comparison \angle 25 (total) with 0.2 ppm (extractable) is difficult. Core holes are located in the mining plan but not in the draft EIS (p 117). Core hole data are not correlated to show that less than one hole per 40 acres is acceptable (30 CFR 211.10(c)(6)(xii)).

19 19. The statement on page 121 regarding the ability to burn this coal in conformance with EPA standards and in a manner where emissions pose no health hazard does not apply in areas where ambient EPA and State

Construction of ground-water barriers (p. 536-546) should not adversely affect the stability of the reclaimed spoil materials, regardless of whether or not the barriers are breached after mining is completed.

7A The spoils aquifer in both the East Decker and North Extension areas would eventually tend to become saturated to approximately the spillway level of the Tongue River Reservoir (3,424 feet), regardless of the presence or absence of the barriers. In any event, the level of saturation in these permeable materials would not rise above the bottoms of the lowest channels that traverse the reclaimed mined areas. The undisturbed bedrock between the mined areas and the reservoir would prevent any mass movement of the saturated spoils towards the reservoir.

7B The primary effect of the barriers after mining would be to prevent cyclical circulation of ground water between the reservoir and the reclaimed mined areas as the reservoir is alternately filled and emptied during normal use. The effects of breaching the barriers is discussed on p. 544-545.

8A As stated in the response to comments 1A and 1B above, the proposed mining plans discussed in section I for both the East Decker and North Extension areas have been submitted by the applicant for approval and are the subject matter of the FES. Alternate Mining Plan B-3 (Plan B in the FES) has been expanded (p. 696-672, and figs. 76-83) to enable appropriate evaluation of that proposal. The postmining topography under this alternative plan (fig. 80) would approximate the original contour and would greatly enhance the stability of postmining channels.

8B Mitigating measures for impacts stemming from the eventual failure of the Deer Creek diversion are discussed on p. 555-556. Sedimentation ponds were not made a part of the postmining drainage network, partly because they eventually would fill with sediment and require maintenance, but largely because the long-term sediment yield to the Tongue River Reservoir--assuming stabilization of channels over the highwall (p. 556-559)--would probably be less than the premining rate (p. 561).

8C Gradients of channels draining over the highwall would not be left at 1:5 (20%). The Decker Coal Co. has stated that it will adopt the mitigating measures described on p. 556-559 (Jack Reed, Decker Coal Company, oral communication). Those measures include reduction of the slope of channels over the final highwall to the maximum extent practicable, probably to less than 10%.

8D Although data are not generally available, given the vagaries of climate, etc., to quantitatively assess the problems associated with reestablishing stable ephemeral stream channels over a highwall and across a reclaimed mined area, an understanding of geomorphic principles and processes allows one to predict the sequence and general magnitude of events that would be expected in the Decker area. For example,

standards are exceeded, or where significant deterioration of air quality is not permitted. Burning of the coal could pose a local health problem if the coal were used to fuel a new facility as opposed to replacing coal of poorer (sulfur) quality already in use.

20. It is unfortunate that only the generalized maps of water flow (p 153), figure 41) were used and that those maps prepared by Van Voast and Hedges were not presented. It is critical that depth to water and post-mining topography be directly compared to show whether sub-irrigation will occur.

21. The lack of ambient surface water data is, of course, of great concern. The location of those gauging stations employed is not shown.

22. In what manner has there been an assessment of the need for the additional railroad spur for the proposed mining as opposed to use of expanded facilities at West Decker and use of a conveyor or other system to transfer coal to the existing rail head?

23. In general, the EIS has made a good effort to identify air quality impacts associated with the Decker mine. The data base and the approach to estimating emissions are good. Also, the discussion of planned and potential mitigating measures is adequate. Two primary deficiencies stand out, however. The presentation of the calculation of emissions in Appendix C is filled with errors to the point of substantial confusion. Secondly, the discussion of mitigating measures does not tie down what measures will in fact be taken. Only a few measures are presented as being firm; the rest are a shopping list of "could be's".

24. What is the relationship of the project with the Decker-Birney MFP?

25. How can the Dietz 2 seam include only 1,110 acres and be under the total mine area? (Table on p 24).

26. It is noted that ground water entering the pit will be 50,000 gal/day and also that this water will be pumped into mine-water treatment ponds where water is treated as necessary before release. The EIS should discuss the fact that an NPDES (discharge permit) will be needed and that effluent guidelines have been proposed for coal mine drainage. This discussion should include the role of the permit and the proposed guidelines in the mine operation.

27. How much water will be used for dust control?

28. There is a question on coal transport. It is noted on p 74 that 16 to 17 unit trains per week will be used. This amount will not handle a 20 million tpy rate (16 trains per week x 10,000 tons per train x 52 weeks per year = 8.3 million tpy). Appendix C says 182 unit trains for D.N. per year?

there is little doubt that (1) extensive valley trenching would occur upstream from the highwalls in the Decker area if the channels over the highwalls are not stabilized, (2) in any event, appreciable aggradation very probably would occur downstream from the highwalls on the mined area because of the reduction in slope, etc., and (3) streams everywhere are constantly readjusting channel dimensions and parameters to better achieve local geomorphic equilibrium. Erosion and sedimentation are the processes by which a stream reestablishes geomorphic equilibrium following surface disturbances such as those caused by mining. It is virtually inevitable that approximate geomorphic equilibrium would eventually be reestablished in the Decker area following mining. The primary uncertainty is the time that would be required to reestablish approximate equilibrium.

The roughness coefficient 0.030-0.035 was recommended for use in channels having a clinker lining with particles up to 5 inches in diameter (see p. 553).

Comment does not require a response.

Additional mitigating measures described on p. 552-561 could be required of the operator by the Secretary of the Interior or by the Commissioner, MDSL, in the form of stipulations to be attached to the mining permit. The text specifically separates and identifies those measures (p. 552-556) that could be used to construct stable diversion channels that would function properly over the life of the proposed mines (concrete drop structures are included in this category). Those measures that would reduce erosion and sedimentation generally over the long term are described on p. 556-561.

The Montana Department of State Lands could require approximate reconstruction of principal stream valleys such as Pearson Creek valley in the North Extension area. If so, the post-mining topography in both the East Decker and North Extension areas should satisfy performance standard 211.40(a)(2) as well as the proposed revision of this standard contained in FR 41-165-35716. Otherwise the Decker Coal Co. would have to seek a variance pursuant to 30 C.F.R. 211.74. The text (p. 527) has been revised accordingly.

According to the proposed mining plan for the East Decker area, all coal would be mined that could be economically recovered using draglines as described in section I.A.2. and depicted in figure 8. The Dietz 2 coal bed could not be economically mined by this method in the south and southeastern parts of the mine area (fig. 4) where the thickness of overburden and interburden exceeds 170 feet.

29. It is stated (p 103) that mining could cause a particulate concentration (24 hours) of 500 ug/m³. What is the basis for this calculation? Is this a measured value or a predicted value?

30. On pages 121, B-18, and B-19, values of Cu and Se are shown but appear to be lower than what we would have expected. Graphically, this would be:

| | EIS | Trace Element Report (attached) |
|----|--------------|---------------------------------|
| Cu | 8.6-9.2 ppmw | 31-34 ppmw |
| Se | 0.4-0.9 ppmw | 1.6-2.2 ppmw |

31. Tables 30 and 41 (C-2) are diesel truck and locomotive emission factors, not fugitive dust. Table C-2 gives fugitive dust.

32. The EIS (pg. C-3) says 325 acres will be disturbed at Decker N. The EIS also uses 67 acres in eqn to calculate fugitive dust and concludes 2.74 ton/year, then rounds to 13. A similar calculation is made for E. Decker. How many acres are used? The EIS then uses a figure of 8 ton/year. Can we assume then that:

| | | |
|---|-----------|-----------|
| E | 325 acres | 13.33 tpy |
| N | 67 acres | 2.74 tpy |

33. On page C-3, there is a reference for 0.36 #/ton of overburden emission factor. PEDCo (under an EPA study) would use 0.05 and the same for coal removal.

34. On page C-6 concerning overburden recontouring, the figure of 300 acres is used. The EIS earlier used the figures of 325 acres at E. and 67 acres at N.

35. Emission calculations for overburden recontouring at E. should be greater than, not less than, Decker N. (340 N. Vs. 220 E.) (p 341). Also, this discussion again raises questions. Why is the 300 acres N. figure used for N.? Is it 12 (C-6) or 2 as in pg 401?

36. The coal processing particulate emissions are not summarized in Tables 30 and 41 (p C-7). They are not even shown. We believe this should be corrected.

37. Tables C-3 and C-4 are not shown. They are to summarize estimated annual emissions from diesel exhaust for N. and E.?

38. Wind erosion of spoils will be a major factor and is not mentioned in Appendix C. This should be corrected.

Revision of the mining plan as described in Alternate Plan B (section VIII.E.) to avoid spoiling into Deer Creek Valley would result in overburden removal by a truck-shovel fleet instead of by draglines. This method would permit recovery of the entire Dietz 2 coal bed within the mined area, but the overall operation would be much less profitable to the Decker Coal Co. According to the Area Mining Supervisor of the USGS, the fact that more coal could be recovered under Alternate Plan B does not in itself mean that the original proposal would not meet the extraction requirements established by 30 C.F.R. 211.4(b). Recovery of the additional coal resource cannot be required of the lessee unless the overall operation is economically feasible. In this case, mining in the East Decker area under Plan B would be economically feasible and probably would be required by the Area Mining Supervisor.

Under the proposed mining plan for the North Extension area, all coal in the Anderson, Dietz 1, and Dietz 2 beds would be recovered (see response to comment 3 above).

The Decker Coal Co. initially requested a modification of existing leases to include those coal resources underlying 320 acres in sec. 3, T. 9 S., R. 40 E., and 400 acres in sec. 34, T. 8 S., R. 40 E., (see p. 661-662 of DES). The Company, however, withdrew its application for lease modifications upon passage in 1976 of the Federal Coal Lease Amendment Act, P.L. 94-377, because section 13 of that act limits areas to be incorporated into existing leases to 160 acres or less. Instead, the BLM tentatively will hold a competitive coal lease sale for these 720 acres in May 1977. Terms of that lease sale will include a royalty of 12.5 percent of the value of the additional coal mined in sections 3 and 34. The text (p. 772-773) has been revised to show these changes.

Chapter IV has been expanded in the FES to include additional discussion of possible actions that the city of Sheridan and Sheridan County may take to ease the anticipated impacts to community development and to social structure and social services should the Decker mine expansions be approved (see text revisions p. 590-610).

Federal regulations 30 C.F.R. 211.3(c)(1) adopted May 17, 1976 require that the Area Mining Supervisor, USGS, inspect operations on Federal coal as frequently as necessary, but at least quarterly, to assess among other aspects of the mining operation the adequacy of the reclamation of affected lands and the protection of the environment. The MDSL will continue to enforce all provisions of the Montana Strip and Underground Mine Reclamation Act at least until such a time as an appropriate agreement is reached with the Secretary of Interior as set forth in 30 C.F.R. 211.75(b). It is the Department of Interior's position that review under 30 C.F.R. 211.75(a) does not affect Montana's right to regulate reclamation under its laws and regulations.

This number apparently was inadvertently omitted from the detailed list of comments submitted by EPA.

39. Are any of the "other possible mitigating measures" going to be implemented (ref. p 531, Chapter IV)? All we see committed to be done is coverage of conveyors, silo storage and water haul roads. What controls will be placed on loadout? Some control will be necessary on coal unloading (feed to crusher), on silo storage, and on sleeve on loadout.

40. Will blasting be a significant or an insignificant environmental impact (ref. p 532)?

The Montana Department of State Lands and the U.S. Geological Survey have no laws or regulations regarding mulching and irrigation in conjunction with reclamation of strip-mined lands.

Mulching is a reclamation technique that is always utilized by the Decker Coal Co. in their attempts to reestablish vegetation on regraded mine spoils (Jack Reed, Decker Coal Co., oral communication). After seeding, a commercial wood-fiber mulch in a water solution is spread on the surface (hydromulching). Mulch applications are typically applied in the spring or fall periods in conjunction with seeding operations.

17 Irrigation equipment would be available to the mine sites should the Decker Coal Co. find it necessary to irrigate to establish seedlings necessary in reestablishing vegetation at the West Decker mine.

It is important to note that application of irrigation water to re-vegetated mine areas for a prolonged period could adversely affect the establishment of a permanent, diverse, and primarily native plant cover as required by the Montana Strip and Underground Mine Reclamation Act, and resulting regulations.

The figure "25 ppm" for lead in table B-3 indicates that the method of analysis did not detect any lead in the sample, but since this analytical method only detects amounts of lead more than 25 ppm, it reports that the value is something less than 25 ppm. The average concentration of lead in shales in the earth's crust is 20 ppm (Turekian and Wedepohl, 1971, table 2) so values less than this amount are not considered significant. An appropriate footnote has been added to table B-3, Appendix B.

18B Core holes from which overburden samples were obtained are located on figure 38. Core hole numbers listed in table B-1 (Appendix B) have been added to figure 38 to show sample locations. Reference to figure 38 has been added to p. 127.

18C The Decker Coal Co. is currently drilling additional overburden core holes to comply with provisions set forth in 30 C.F.R. 211.10(c)(6) (xii).

19 The statement on page 131 has been revised to indicate that trace-element concentrations in coal from the Decker area are equal to or less than the national average for trace elements in coal (Swenson, et al., 1976). Burning this coal as proposed in existing electric-generation plants in Illinois and Michigan and in a new plant under construction in Texas as proposed should not cause trace-element related problems or violate applicable EPA standards regarding trace-element concentrations.

- The potentiometric surface maps prepared by Van Voast and Hedges (1975) are highly technical and would be of little or no value to the average reader. Technical data of this type are readily available in published sources.
- 20 As stated on page 536, water levels after mining would probably rise to a level slightly lower than the premining level because of the inferred higher permeability of the spoil materials, and thus, a corresponding decrease in hydraulic gradient across the mined area toward the reservoir. The maps prepared by Van Voast and Hedges (1975) generally reflect confined conditions and could not be directly compared with the post-mining topography to determine where subirrigation would occur. Subirrigation is tentatively expected only along the bottom of Spring Creek valley across the mined area.
- 21 The locations of all gaging stations in the Decker area are shown in figure 70.
- 22 See technologic alternatives to the proposed action, Coal transportation systems, section VIII.H.3.
- 23A Calculation of emissions (p. C-2 to C-12, Appendix C) has been revised consistent with data used in Volume I.
- 23B Those mitigating measures that are described in section IV.B.4.a. would be initiated by the Decker Coal Co. Measures described in section IV. B.4.b. are other mitigating measures in addition to those proposed by the Decker Coal Co. that are generally regarded by the task force as having merit. These additional measures could be attached as stipulations to the mining permit. See response to comment 2C above and text revisions on p. 509.
- 24 The Decker area lies within the Decker-Birney Resource Study Area as outlined in the report prepared by the U.S. Bureau of Land Management and the U.S. Forest Service (1974). The proposed mines lie wholly within the area recommended in this report for leasing and for surface mining of coal. The Decker Coal Co. proposals, therefore, are consistent with the Decker-Birney Management Framework Plan (MFP).
- 25 The table on p. 28 refers to the area of each coal bed that would be mined under the proposed plan and not to the total area underlain by each coal bed. The text has been revised to clarify this point.
- 26 The text (p. 536) has been revised to include the requested information. See also response to comment 4A.
- 27 An estimated 80,000 gal/day would be used for dust control under the original proposal for the East Decker mine (p. 52). An estimated 444,000 gal/day would be used under Alternate Plan B for the East Decker area (p. 728-729). An estimated 30,000 gal/day would be used under both the original and alternate plans for the North Extension area (p. 77).

According to the proposals, about 6.7 million tons per year (tpy) would be mined from the East Decker mine (p. 17, DES) and about 2.3 million tpy would be mined annually from the North Extension area (p. 50, DES) or a total of 9 million tpy from both proposed mines. The figure 20 million tpy is the rounded total of annual production from all three mines. On p. 74 of the DES it states that "*** combined production from the two mines would require about 16 to 17 unit trains per week ***." Recalculation shows that these figures more properly should be 17 to 18 unit trains per week. The text has been changed accordingly. The example in Appendix C has been corrected to show 230 unit trains per year from the North Extension area.

28

See text revision p. 108. The Bureau of Indian Affairs (U.S. Department of Interior, 1974, p. 47-48) states that dust storms on the Crow Indian Ceded Area in eastern Montana have lowered visibility to less than one mile. Converted into particulate measurements this would equal approximately 500 mg/m³.

29

These values for Cu and Se are comparable with those from other coal beds in the Northern Great Plains region, which are much lower than values for Cu and Se from coal beds in the Appalachian or Interior regions (Swanson and others, 1976, tables 7C, 16C, and 29C).

30

The text p. C-2 has been revised to show correct references to table numbers.

31

All emissions calculations in Appendix C have been reviewed and apparent discrepancies have been corrected (see p. C-2 to C-12, Appendix C). Appropriate changes have also been made in Volume I. Data showing estimated fugitive dust or particulates in tons per year are presented in tables 36 and 41.

32

The text and emission calculations have been revised as suggested using an emission factor of 0.05 lb/ton of overburden instead of 0.36 lb/ton of overburden. The Task Force agrees that the latter figure is too high.

33

See response to comment 32 above. Corrected figures are 130 acres annually for the East Decker mine and 67 acres annually for the North Extension mine.

34

See response to comments 32 and 34 above. Corrected figures for uncontrolled particulate emissions from overburden recontouring are 150 tons/yr for the East Decker mine and 75 tons/yr for the North Extension mine. The correct figure for emissions from topsoil removal at the North Extension mine should be 3 tons/yr (see table 41).

35

Coal-processing particulate emissions for the East Decker and North Extension mines are given in tables 36 and 41 in Volume I of the FES. The confusion was introduced by inadvertently misnumbering tables in Appendix C. The text has been revised accordingly.

36

Tables C-3 and C-4 were included in Appendix C, but inadvertently had been misnumbered as table 38 and 41 (see response to comment 36 above). Following appropriate revision of Appendix C, tables C-3 and C-4 have been renumbered and are included in the FES as tables C-2 and C-3.

37

Computation of uncontrolled particulate emissions from wind erosion of spoils has been included in Appendix C as suggested. Results of computations are listed in tables 36 and 41.

38

The Montana Department of Health and Environmental Sciences is currently processing permit applications for (1) an air-quality construction permit for the proposed East Decker coal-handling facilities and (2) an air-quality operating permit for the existing West Decker coal-handling facilities (see text revision p. 564-565). Should these permits be issued, it would indicate that the coal processing designs and/or operations were consistent with the best available control technology for preventing and abating air pollution. To bring the applicant into compliance with the Montana Clean Air Act, the Department of Health and Environmental Sciences may require that additional or improved control technology be integrated into the Decker Coal Co.'s coal-handling facilities in the West Decker area and proposed facilities in the East Decker area (see text revisions p. 664-665). Some of the additional mitigating measures listed on p. 557-569 of the FES or others may be required by the Department of Health and Environmental Sciences to bring the Decker Coal Co.'s coal-handling facilities into compliance with the Clean Air Act.

39

Under Alternate Mining Plan B for the East Decker area, the Decker Coal Co. proposes to use a water-based spray to better suppress dust emissions during the primary coal-crushing process and during the subsequent coal-handling and coal-loading processes (see text revision p. 764). Also, the construction designs for the East Decker facilities that have been submitted to the Montana Department of Health and Environmental Sciences show that "rotoclone" dust catchers would be installed at transfer points along the coal-conveyor system and that an oil-spray system would be installed so that the coal may be sprayed immediately prior to being loaded onto railroad cars. A similar oil-spray system is currently being installed at the West Decker coal-processing facility.

40

Blasting activities are not foreseen as producing any significant environmental impact. See text revision p. 568.



LETTER 2

DEPARTMENT OF THE ARMY
OMAHA DISTRICT, CORPS OF ENGINEERS
6014 U.S. POST OFFICE AND COURT HOUSE
OMAHA, NEBRASKA 68102

MRDPD

16 November 1976

Director, U. S. Geological Survey
National Center, Mail Stop 8
Reston, Virginia 22092

Dear Sir:

This responds to your undated notice informing us that the draft EIS on the proposed plan of mining and reclamation for the East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana was filed with CEQ on 13 October 1976. You inclosed a copy for our review and comment.

We have reviewed the draft EIS and find that only minor impacts will occur to Corps of Engineers projects or potential projects from on-going studies. There is an existing Corps of Engineers local protection flood control project at West Glendive, Montana downstream of the proposed mining area. We also have a proposed flood control project for Miles City, Montana under study. Since both of these are levee projects, the proposed mining expansion could only affect the projects if the hydrologic characteristics of the Tongue River were changed through increased sedimentation of the Tongue River Reservoir as a result of the proposed mining expansion. With adequate sediment controls on the site this should not happen.

We note the EIS acknowledges that the leaching of spoils and pumped mine drainage will significantly increase the dissolved solids in the Tongue River Reservoir. The draft EIS does not, however, characterize these additional dissolved solids nor does it, in our opinion, adequately assess the downstream water use impacts of such increases.

You should also note that Department of the Army permits pursuant to Section 404 of the Federal Water Pollution Control Act, as amended, will be required prior to the start of construction for any filling or dredging activity in streams which flow more than 5 c.f.s., 50 percent of the time; natural lakes larger than 5 surface acres; and their adjacent or contiguous wetlands. Since your draft is not site specific for such local streams or wetlands which may be affected, additional project details and other

The dissolved-solids content and character of the ground water discharged to the Tongue River Reservoir as a result of leaching of spoil materials in the East Decker and North Extension areas are discussed in sections III.A.3.a.(4) and III.B.3.a.(4), respectively. The text in section III.C.3.a.(5) (p. 444) states that the cumulative effects of the leaching of spoils and of discharging mine effluent to the Tongue River Reservoir from the two proposed mines would be so small as to have virtually no detrimental effect on the use of the reservoir or its water. Similar statements are made on pages 589, 625, 627, 638, 691, 692, 737, 785, and 802.

The text (p. 518) has been revised to indicate that the Decker Coal Co. must obtain a permit pursuant to Section 404 of the Federal Water Pollution Control Act before undertaking any activities that would dredge or fill lands lying below spillway level (3,424 feet) within the Tongue River Reservoir.

All streams in the proposed project areas (fig. 3) are ephemeral and have discharges less than 5 ft³/s. Wetlands that would be affected by the proposed operations lie below spillway level (3,424 ft) in the southeastern and southwestern parts of the Tongue River Reservoir. Embayments of the reservoir would be filled in conjunction with construction of the access road and railroad spur to the proposed East Decker mine (figs. 3 and 5) and relocation of Route FAS 314 in the North Extension area (fig. 13). Areas of the reservoir that would be filled are currently devoid of permanent vegetation and are sites of sediment accumulation (fig. 47). Impacts and mitigations related to these actions are described in appropriate sections of the FES.



MROPD

Director, U. S. Geological Survey

16 November 1976

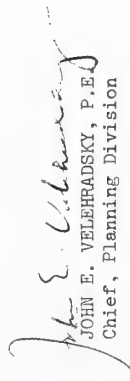
2B information may be needed to make an environmental assessment or supplement the EIS in connection with the permit process. If you are not familiar with the permit regulations, additional information can be obtained from this office upon request. Please write to:

District Engineer
Omaha District, Corps of Engineers
ATTN: Operations Division
6014 U.S. Post Office and Courthouse
Omaha, Nebraska 68102

Please note that this review of your draft EIS is not intended to convey or give Corps of Engineers approval to the draft EIS or to the proposed project in connection with any Section 404 permit action or procedures.

We appreciated the opportunity to review and comment on your draft EIS.

Sincerely yours,


JOHN E. VELEHRADSKY, P.E.
Chief, Planning Division



LETTER 3
UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545

JAN 19 1977

Director
U.S. Geological Survey
U.S. Department of the Interior
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir:

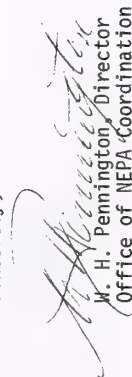
This is in response to your transmittal dated October 8, 1976, inviting the U.S. Energy Research and Development Administration (ERDA) to review and comment on the draft environmental impact statement on the proposed plan of mining and reclamation for the East Decker and North Extension mines, Decker Coal Company, Big Horn County, Montana.

We have reviewed the draft statement and have determined that the proposed action will not conflict with current or future ERDA programs.

However, we are enclosing staff comments for your consideration in the preparation of the final statement.

Thank you for the opportunity to review and comment on the draft statement.

Sincerely,


W. H. Pennington, Director
Office of NEPA Coordination

Enclosure:
ERDA Staff Comments

cc w/enclosure:
Council on Environmental Quality (5)



ERDA STAFF COMMENTS
ON THE
USDI/GS DRAFT ENVIRONMENTAL IMPACT STATEMENT
EAST DECKER AND NORTH EXTENSION MINES
BIG HORN COUNTY, MONTANA

Revegetation Alternatives

- 1 The introduction of nonnative species should be substantiated in the final statement by a consideration of their characteristics compared to the native species.

- 2 We suggest that the final statement discuss the possible or probable successional changes to be expected following any of the possible revegetation strategies. The successional futures of the revegetation seedings should be pointed out. If they are unknown, this should also be noted.

Several problems arise when trying to reconstruct vegetative communities with the species that were present prior to disturbance. Some species produce viable seeds at infrequent intervals, and therefore, seed is unavailable for these species for many years. Other species produce seed, which although viable, may lie dormant for a number of years. By using native species, complemented by introduced species, it is hoped that a rapid permanent cover can be produced that will function in a similar ecological fashion to the cover which existed in the premining communities.

1

The three introduced species proposed by the Decker Coal Co. appear well suited for reclamation in the Decker area. Smooth brome is a vigorous sod producer well suited to erosion control. Sainfoin, being a legume, will aid nitrogen fixation in the disturbed soils. Pubescent wheatgrass is a permanent drought-resistant grass that is well adapted to soils in the area.

The climax plant communities that would develop on revegetated mine areas in the Decker area cannot be accurately predicted from available data and from results of research to date. Observations by MDSL staff at similar revegetation attempts in other mined areas permit only speculation as to the plant communities that would occur during the first few years after revegetation. Despite the attempt to create a stable near-climax plant community by seeding selected seed mixtures at controlled rates, plant composition on revegetated mined areas can be expected to change over time because of invasion of other plant species, climatic variations, organic matter buildup, and soil development. The extent to which these changes will occur, however, is unknown.

2



IN REPLY REFER TO:

LETTER 4

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240

1793 (962)
(731)

DEC 1 1976

Memorandum

To: Director, Geological Survey
From: Director, Bureau of Land Management
Subject: Review of Draft Environmental Statement (DES), Proposed Plan of Mining and Reclamation, East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana DES 76--40

The following are comments on the subject DES that have been compiled following our review at the Montana State Office and Miles City District Office. In July 1976, we reviewed the Preliminary Draft Environmental Statement and note that our comments following that review have been incorporated into the DES.

1 - 17

1 The first page of this document, the SUMMARY, does not clearly indicate what the Federal and State actions that constitute the proposed action are.

2A The information on wildlife impacts should be tabularized; for example, estimates of the number of the various big game animals per section within the study area currently and at relevant intervals in the future, with and without mining could be tabulated. Such tables capsule the essence of the detailed and sometimes confusing discussion that necessarily appears in the text. While such population estimates are necessarily very rough, if they represent the best judgement of wildlife professionals, they are of value to readers of the environmental impact statement who otherwise would have to either implicitly or explicitly make such estimates themselves. The discussion regarding non-game wildlife should be expanded.

2C If such items as Decker Coal Company's statements concerning the welfare of mule deer populations are corroborated by the Montana Fish and Game Department, then such corroboration should be documented as the authoritative source of such information. Decker Coal Company should not be used as the authoritative source of information in areas where they do not have professional expertise. It would appear that in matters concerning resident wildlife, the Montana Fish and Game Department or BLM biologists are the primary

1 See text revision on summary page.

2A The minimal data available from which to assess the impacts on wildlife preclude tabularizing. Should an attempt be made to quantify data on impacts, the resulting estimates necessarily would be very generalized and, as such, would be meaningless and possibly might be misleading.

2B Data are not available from which to expand the discussion of nongame wildlife.

Decker Coal Co. retains a professional wildlife biologist on their staff. This biologist collaborated with other wildlife professionals working in the Decker area, including employees of the Montana Departments of Fish and Game and State Lands, the Montana State University, and the U. S. Fish and Wildlife Service. Wildlife data and analyses presented in the FES were approved by biologists working for Montana Dept. of State Lands and Montana Dept. of Fish and Game. See p. 369 and 425 for text revisions regarding reasons for mule deer sightings within the boundaries of the West Decker project area.



2C authoritative sources of information. In matters of waterfowl or migratory birds, the primary authoritative source would be the Fish and Wildlife Service.

3 The overall impression presented in Chapter 3, ENVIRONMENTAL IMPACTS OF THE PROPOSAL, is that of "negative" impacts due to strip mining operations. The "positive" impacts should be presented as an appropriate part of this chapter of the environmental statement.

4 Page 36 - Proposed plan advocates the use of fertilization, irrigation, and mulching. These are excellent methods of aiding the establishment of quick ground cover. However, any prolonged use of these practices will produce a pseudo environment and prevent the reclaimed area from establishing a native ecosystem. Mitigating measures and stipulations should be developed that discourage use of fertilization, irrigation, and mulching except for initial stand establishment. This process would comply with State of Montana revegetation requirements on strip mines.

5 Pages 347-353, 403-408, 434-436 - Some beneficial impacts may occur on certain species of wildlife during the reclamation process (i.e., small mammals, mice, etc.). A discussion of these beneficial impacts has been avoided. The whole wildlife impact discussion appears to have a very "negative" slant.

6 Chapter 4, MITIGATING OR COMPENSATING MEASURES, appears to be well organized and generally well presented. It starts with a discussion of Federal, State, and local laws and then discusses the mitigating measures in the reclamation plans for each environmental component. Under each environmental component, the proposals of the Decker Coal Company are discussed, followed by discussion of other possible mitigating measures. The final section in Chapter 4 on page 548 is titled "Other Actions". The status of these actions should be explained. It is not clear if these other actions have already been agreed to by the Company or if they are merely additional suggestions for the analysis team.

7A Tables 17 and 40 indicate a high probability that the artificial stream valleys of Spring and Pearson Creeks would be inadequate to pass a 25 year or 50 year high storm which could occur during the life of the mine. The relocated valley (after mining has been finished) would be over unconsolidated replaced material. This, too, could be expected to be devastated by a 25 year or 50 year high storm. What provisions have been considered to mitigate this impact or rectify the probable damage? Would the coal company be obligated to compensate for the restoration?

3 Positive impacts are presented as part of Chapter III; for example, see sections III.C.9., III.C.16., and III.C.18.

4 Available data indicate that prolonged use of fertilization, irrigation, and mulching, except for initial stand establishment, does not promote the development of a permanent, diverse, and primarily native vegetative cover as required by the Montana Strip and Underground Mine Reclamation Act and rules adopted pursuant thereto. Discussion of possible reclamation methods that may reduce the need to mulch, fertilize, or irrigate are presented on p. 572-575 and p. 817-818. See also letter no. 1, comment 17.

5 Data collected on small mammal populations in revegetated mined areas indicate that certain small mammals such as deer mice quickly reestablish themselves after mining. Data on the long-range impacts to such populations, however, are lacking, as are data for species that do not quickly reestablish themselves, such as antelope and sage grouse. Discussion of mining-related impacts for most species in the Decker area is largely professional speculation based on wildlife reactions to similar types of disturbances in other areas.

6 Section IV.C. entitled "Other actions" is misleading. The heading has been changed in the FES to "Mitigating measures to impacts extending outside the proposed mine areas."

7A Diversion channels to carry runoff around the proposed mine areas must be redesigned to prevent local failure in response to moderate or larger flood events. The Decker Coal Co. is currently working on those designs for the North Extension area and has completed the design for an alternate diversion system for the East Decker area (section VIII.E.2.C.(5)). It should be noted, however, that failure of these channels during mining would generally result only in minor flooding of the mine.

Mitigating measures that would enable construction of essentially stable postmining channels are described in section IV.B.3.b.(2)(b). In actuality, however, no natural ephemeral stream channel would be stable during a 25-year or larger runoff event. A storm of that magnitude can be expected to cause considerable local scour and appreciable sediment movement, followed by a long period of channel readjustment. There is no reason to believe that a runoff event of any given magnitude across the reclaimed mine area would be any more destructive than a comparable runoff event before mining, provided that the channel over the highwall remains stable.

7B The coal company would not be obligated under a performance bond, following satisfactory completion of reclamation of the mined area and release of the bond, to compensate for the restoration of the reclaimed area in the event of a destructive flood.

Pages 661-694 - The description of mining in the modified North Extension indicates that all cuts would be essentially North-South and parallel to the box cut near the river. Would this alternative be feasible? After the first 3 or 4 cuts, would it be possible to make a new box cut running east-west (along the northern boundary)? Subsequent cuts would move southward. When the valley of Spring Creek would be passed through, Spring and Pearson Creeks could be directed into the eventual channel shown in Fig. 84. This procedure would allow more time for stabilization of the new channel, while mining equipment would be available in case of channel failure.

8

Archaeology - The treatment of archaeological and historical sites is completely lacking in solid analysis. This occurred because the agencies preparing the DES based their analysis of "no significance" for the sites found on a 1975 preliminary report submitted to Decker Coal Company by Ms. Lynn B. Fredlund, Archaeologist, Mineral Research Center, Butte, Montana. The problem with this analysis is that it is not based on a final analytical report by the archaeologist involved. Although the preliminary report gave the impression that the sites were not significant, it was merely a "best guess" by that archaeologist. She did not make these statements from careful and systematic analysis of the artifacts recovered, nor in most cases were the sites tested for subsurface remains by more extensive means than a simple auger hole. Given the fact that the archaeology of this area of Montana is only in the initial stages of being known, a "best guess" is clearly not adequate reason to cause destruction of these archaeological sites.

9A

Contact with the Mineral Research Center indicates that Ms. Fredlund has prepared a further interim report (mistakenly labeled The 1975 Archaeological Survey and Testing of Decker Coal Company Lands, Big Horn County, Montana: Final Report), and that during the winter of 1976-77, she will be preparing the final analysis of cultural remains from all recent work done for the Decker Coal Company.

9B

Ms. Fredlund expressed strong reservations that her preliminary finding would be used without updating in the Final Environmental Statement. In this, the BLM archaeologist from the Montana State Office reviewing this DES concurs. When the material in this statement is presented as a Final Environmental Statement, it must at a minimum contain the final analyses made by Mineral Research Center in order to describe the past cultural activities adequately in Chapter 2 of the environmental statement, and only then can and mitigating measures be accurately assessed. We suggest that Ms. Fredlund be contacted through Decker Coal Company for early receipt of the final manuscript.

9C

James H. McNeill
SECRET

The orientation of the box cut, the mining sequence, and the simultaneous operation of two separate pits in the North Extension area are essential to coal-blending requirements to meet existing contract specifications. Moreover, the proposed plan allows flexibility in setting the western limit of mining. Higher coal prices 20 years from now probably would permit removal of a greater thickness of overburden and, thus, additional expansion of the mine westward. This would permit greater recovery of the coal resource. Opening a box cut on high ground along the northern margin of the mine area would result in an excessive volume of box-cut spoils. The costs and problems stemming from the handling of these spoils could be prohibitive.

8

The treatment of archaeological and historical sites in the DES has been substantially revised in the FES. See text revisions on p. 297-303, 375-377, 430-432, 494-495, 611-615, and p. 646. Also, see revisions to Appendices H and I.

9A

The report "1975 Archaeological survey and testing of Decker Coal Company Lands, Big Horn County, Montana: Final Report" by Fredlund (1976) was utilized extensively in preparing the FES (see footnote p. 297).

9B

At the time the DES was completed and printed, the "Final Report" (Fredlund, 1976) had not been submitted to the Montana Department of State Lands and, hence, was unavailable for use by the task force. The task force, therefore, used Fredlund's "Preliminary Report" (Fredlund, 1975) in preparing the DES. Revisions in the FES (p. 297-302, 375-377, 430-432, 494-495, and 611-615) are based on Fredlund's 1976 "Final Report."

9C



LETTER 5

United States Department of the Interior

BUREAU OF OUTDOOR RECREATION
WASHINGTON, D.C. 20240

IN REPLY REFER TO:
DES-76/40

NOV 23 1976

Memorandum

To: Director, Geological Survey
From: Director, Bureau of Outdoor Recreation

Subject: Comments on Draft Environmental Statement, Proposed Plan of Mining and Reclamation, East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana

The section on "Recreational facilities and activities in the Decker area" (pp. 290-291) should be expanded to include specific information on where the land-based recreational activities listed occur in relation to the proposed mine areas. Those portions of the Tongue River Reservoir which are popular for the water-based recreational activities noted on page 292 should be identified. A map would present this information very effectively. In addition, such a map should resolve the contradiction between the statement (p. 290) that the Tongue River Recreation Area is in the SE $\frac{1}{4}$ of Section 26, and the map (p. 696) which shows it much closer to the mine and relocated FAS 314, in Section 35.

The final environmental statement should provide quantitative information on the numbers of, and impacts on, recreationists at the Tongue River Reservoir and Recreation Area. Adverse noise and aesthetic impacts on users of the Recreation Area due to the adjacent mining and highway should be evaluated. Although water quality, aesthetic, fishery, and other impacts on the Tongue River Reservoir are mentioned in their respective sections, the section on cumulative impacts on recreation in the Decker area (p. 470) should summarize these impacts on the utility of the Tongue River Reservoir for continued recreational use. This is particularly important in view of the statement (p. 235) that "This reservoir is becoming increasingly important as a recreational area."

The final statement should make specific reference to any Federal, State, or local plans or studies concerning recreation areas or facilities. Special reference should be made to the Montana Statewide Comprehensive Outdoor Recreation Plan (SCORP) which is prepared by the Recreation and Parks Division of the Montana Department of Fish and Game. Montana's

SCORP planners may be able to provide useful information on recreation supply and demand for incorporation into the final statement. For additional information, you may contact Ronnie G. Holliday, Administrator, Recreation and Parks Division, Montana Department of Fish and Game, 1420 East 6th Avenue, Helena, Montana 59601, phone: (FTS) 587-3750.

Section II.C.7 (p. 307-318) has been expanded to include information contained in the Montana Statewide Outdoor Recreation Inventory as well as recent information obtained from the Recreation and Parks Division of the Montana Department of Fish and Game. The section was also expanded to include a map (fig. 63A) showing existing recreational facilities along the Tongue River Reservoir. Lastly, the results of a Montana Department of Fish and Game creel census for the Tongue River Reservoir were included in the FES. The Montana Statewide Outdoor Recreation Inventory provides a generalized description of land- and water-based recreation activities in southeastern Montana, including some specific areas that are popular or have potential for recreation. The Tongue River Reservoir is not included among these areas.

The Recreation and Parks Division reports that information more specific than that presented in the FES on land-based recreation activities in relation to the proposed mine areas is not available. Additional data would have made impact descriptions more site-specific; however, it is unlikely that such data would have significantly changed the analysis presented in the FES. As indicated in the FES, those portions of the Tongue River Reservoir that are popular for water-based recreational activities lie north of the proposed East Decker and North Extension mine areas. More specific information on the location of these water-based recreation activities than that presented in the text and on figure 63A is not currently available (Dick Mayer and Wes Burnett, Recreation and Parks Division, Montana Fish and Game Department, oral communication).

2 See text revisions on p. 808 and figure 63A.

3 Aside from the creel census data given in section II.C.7.c., (p. 311-313), quantitative information on the numbers of recreationists using the Tongue River Reservoir and recreation area are not available.

4 Specific impacts on reservoir and recreation area users are included in sections III.A.8. and III.B.8. Cumulative impacts of the three mines on the utility of the reservoir for continued recreation use are summarized in section III.C.12. Aesthetic impacts (including noise) on the users of the reservoir and recreation area are also described in these sections (p. 495-498). As one's perception of aesthetic degradation varies from individual to individual, it would be difficult, if not impossible, to adequately evaluate such impacts to a degree greater than that presented in the FES.

7 The extensive use of equivocal and indefinite language (could, should, can) throughout the section on mitigating measures leads to confusion over what measures will be carried out. We suggest that the final environmental statement include only those measures which will be implemented, and evaluate the unavoidable adverse effects on that basis.

8 We commend the Decker Coal Company for its contribution to the construction and maintenance of new recreation facilities at the Tongue River Recreation Area, as described on page 562. However, this section includes the statement that "The expected increased use of the Tongue River Recreation Area, as a result of increased mining activity, should be adequately compensated for by the improved quality and capacity of this facility." In view of the lack of a quantified evaluation of recreation in the Decker area, this statement seems unwarranted.

John Crutcher

5 A Preliminary Master Recreational Development Plan for the Tongue River Reservoir is included in Appendix K of the FES. This plan was prepared by the Recreation and Parks Division of the Montana Fish and Game Department.

6 The Montana Statewide Outdoor Recreation Plan (SCORP) was utilized in preparing section II.C.7. Ron Holliday, Richard Mayer, and Wes Burnett of the Recreation and Parks Division, Montana Department of Fish and Game, were contacted for data and suggestions regarding Montana's SCORP.

7 See text revision on p. 509 for a description of the purpose and goals of the chapter entitled Mitigating or Compensating Measures.

8 See text revision on p. 616. The evaluation of recreation in the Decker area has been expanded in the FES to include all available data.

LETTER 6

Advisory Council on
Historic Preservation
1522 K Street N.W.
Washington, D.C. 20005

December 17, 1976

Mr. Henry W. Coulter
Director
U. S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Mr. Coulter:

This is in response to your undated request for comments on the draft environmental statement (DES) for the proposed plan of mining and reclamation for the East Decker and North Extension Mines, Big Horn County, Montana. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council has determined that the DES is inadequate because it does not demonstrate compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f, as amended, 90 Stat., 1320) nor Executive Order 11593, "Protection and Enhancement of the Cultural Environment" of May 13, 1971.

The "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800) provide the guidelines for compliance with the above cited Federal preservation authorities, copy enclosed for your convenience. While the U. S. Geological Survey (USGS) identified cultural resources in the area of the proposed undertaking, apparently no steps have been taken to determine the eligibility of those cultural features for inclusion in the National Register of Historic Places, nor to determine the effect of the proposal on them, or to obtain the comments of the Advisory Council as appropriate pursuant to the steps detailed in Section 800.4 of the "Procedures."

Because numerous cultural resources have been identified which may be eligible for inclusion in the National Register, the Council will be unable to comment until USGS has followed the "Procedures" and requested Council comments pursuant to Section 106 and the Executive Order 11593, as appropriate. Compliance with these procedures requires USGS consult with the Montana State Historic Preservation Officer, Ron G. Holliday, Administrator, Recreation and Parks Division, Department of Fish and Game, Mitchell Building, Helena, Montana 59601.

See text revisions on p. 297-303, 375-377, 430-432, and 611-615. Statements made on p. 355, 409, 470, 588, 629 and 684 of the DES that "impacts to archaeological sites would not be significant" were not intended to imply that a finding of "no adverse affect" pursuant to 36 C.F.R. 800.4 had been made. As detailed below, no archaeological sites within the two project areas are included in or currently held to be eligible for inclusion in the National Register of Historic Places.

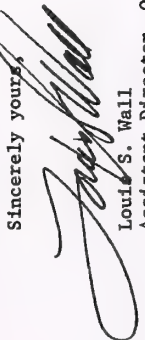
The task force has taken the following steps to comply with the National Historic Preservation Act of 1966, with Executive Order 11593, and with rules and regulations adopted pursuant thereto:

- (1) The task force reports (tables 33a and 33b) that 23 sites having archaeological value have been found within the two project areas by Fredlund (1976) and Lahren (written communication, December 3, 1976). No sites possessing architectural or historical values have been identified within the two project areas.
- (2) The task force consulted the National Register of Historic Places, including monthly supplements, and determined that no archaeological, historical, architectural, or cultural sites are listed that lie within the two project areas. Consultation with the National Register also confirmed that as of March 20, 1977, no nominations were in process for sites located within the proposed mine areas.
- (3) In consultation with the Montana State Historic Preservation Officer, the task force applied National Register criteria to all identified archaeological sites within the two project areas and concluded that, although most of the sites identified do not meet National Register criteria, at least one potential site has not been tested and might eventually prove to be eligible for inclusion in the National Register. After reviewing archaeological studies made in the two project areas, the State Historic Preservation Officer suggested that the following steps be taken to determine National Register site eligibility (Ken Korte, State Historic Preservation Officer, written communication, February 4, 1977):

- (a) The U.S. Geological Survey should advise the State Historic Preservation Officer (SHPO) as early as is feasible on an annual basis of specific acreages within the two project areas that would be disturbed during the following year.
- (b) The SHPO should be allowed necessary time to test or arrange for testing by other parties, those sites that would be impacted by mining or by mining-related activities during that year.

Page 2
December 17, 1976
Mr. Henry W. Coulter
East Decker and North Extension Mines

Should you have any questions or require any additional assistance, please contact Brit Allan Storey of the Council's staff at P. O. Box 25085, Denver, Colorado 80225, telephone number (303) 234-4946, an FTS number.

Sincerely yours,

Louis S. Wall
Assistant Director, Office
of Review and Compliance

Enclosure

The SHPO anticipates that, within several years or less, he would be able to resolve the matter of eligibility for the entire area in question; thereafter, annual review would be unnecessary.

(4) Eligibility of an archaeological site for inclusion in the National Register must be determined by the State Historical Preservation Officer and the Secretary of the Interior as provided in 36 C.F.R. 800.4(a)(2) and 36 C.F.R. 800.4(b). Should any eligible site be found, its eventual destruction would result if the proposals are implemented, unless appropriate protective provisions are made conditions of the approval of the proposed plan. In the absence of appropriate protective measures, application of the "Criteria of Adverse Effect" (36 C.F.R. 800.9) for sites within the proposed project areas, would almost certainly result in a finding of adverse effect on such sites.

(5) In view of a possible, although unlikely, determination that one or more sites within the two project areas would be found to be eligible for the National Register, the U.S. Geological Survey has requested in writing the comments of the Advisory Council on Historic Preservation and has notified the State Historic Preservation Officer of that request. Attached to the letter requesting the Advisory Council's comments were copies of archaeological studies by Fredlund and Lahren, the State Historical Preservation Officer's letter referenced above, and relevant portions of the FES.

The Administrator, Recreation and Parks Division, Department of Fish and Game, no longer serves as the State Historic Preservation Officer. That position is currently held by Mr. Ken Korte, Director of the Montana Historical Society. Results of consultations with Mr. Korte are incorporated in text revisions on p. 375, 430, and 611-615. A copy of Mr. Korte's response is reproduced on p. H-17, Appendix H.



LETTER 7
United States Department of the Interior

NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:

L7621 (RMR)CS

DEC 1 1976

Memorandum

To: Director, Geological Survey

Through: Assistant Secretary for Fish and Wildlife and Parks *See file*

From: Director

Subject: Draft Environmental Statement, Proposed Plan of Mining and Reclamation, East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana (DES 76-40)

As requested in your memorandum of October 8, 1976, we have reviewed the subject statement and offer the following comments.

1. One interesting historical aspect of the use of this area has been omitted from the discussion of Archeological and Historical Sites on pages 288 to 290 of this document. We note that no mention is made of the fact that the Tongue River Valley played an important role in the settlement and development of the cattle industry in Montana and the Dakotas.

2. The final environmental statement should establish that the most current listing of the National Register of Historic Places, as published in the Federal Register of February 10, 1976, and all monthly supplements have been consulted.

The statement does not establish that the State Historic Preservation Officer for the State involved was consulted. He is Mr. Ron G. Holliday, Administrator, Recreation and Parks Division, Department of Fish and Game, State of Montana, Mitchell Building, Helena, Montana 59601. The final environmental statement should reflect that he was consulted to determine whether the proposal will affect any cultural site which may be in the process of nomination to the National Register of Historic Places and contain a copy of his response.

1. See text revisions on p. 305-306.

2. See text revisions on p. 375 and 430. See also letter from State Historic Preservation Officer (p. H-17 to H-18, Appendix H).

3. The Administrator, Recreation and Parks Division, Department of Fish and Game no longer serves as the State Historic Preservation Officer. That position is currently held by Mr. Ken Korte, Director of the Montana Historical Society. Results of consultations with Mr. Korte are incorporated in text revisions on p. 375, 430, and 611-615. A copy of Mr. Korte's response is reproduced on p. H-17 to H-18, Appendix H.



4 See text revisions on p. 297-303, 375-377, 430-432, 494-495, 611-615, and 646. See also Appendices H. and I.

We note that there have been professional surveys for cultural resource sites in the two respective study areas, and that fourteen archeological sites were identified. We also note a commitment by the Bureau of Land Management to complete a professional survey of lands under their jurisdiction that will be affected by the proposed land use as they obtain permits.

All additional lands that could be affected by the project developments not previously surveyed should be surveyed as well by a professional archeologist. Such lands should include any dam sites; diversion channels or ditches; access and haul roads; railway spur and powerline right-of-ways; sites where project-associated buildings and structures, and equipment storage facilities will be erected; and all other areas of project-related terrain.

4 Such action is consistent with the requirements of Executive Order 11593, Section 1(3) and the U.S. Geological Survey's "Coal Mining Operating Regulations," Section 211 4(d) (9) (36 CFR, Part 211). The results of all professional survey work should be fully detailed in the final environmental statement along with the specific comments and recommendations of the principal investigators.

5 Of the archeological sites identified, all but one have been found to be of little significance. However, in the case of the one site which was thought to merit further test excavations, the final statement should establish whether it meets the criteria of the National Register. If this is found to be the case, there will then be a need to establish whether the effect noted will be adverse; the assertion that the proposed project will have no adverse effect on archeological values may require revision.

6 The final environmental statement should also establish what the effect upon any sites identified, that are eligible for listing in the National Register, will be. It should also include specific guidelines for immediate work stoppage, notification of the State Historic Preservation Officer, examination by a professional archeologist, and a discussion of appropriate mitigative measures, when previously unknown

Fredlund's (1975) preliminary archaeological report, which was utilized in preparing the DES, indicated that site 24BH1524 merited further testing in hopes of locating charcoal for radio-carbon dating. Subsequently, Fredlund's (1976) final report, which was utilized in preparing the FES, states that after examination and testing of site 24BH1524 no charcoal was found because the ridge crest on which the site is located "*** had been washed through erosion causing considerable redistribution of the heat-fractured rock and totally washing out any charcoal which may have originally been present," (see p. 297-303, and p. H-28, Appendix H). The FES reports that site no. 24BH1524 (NW $\frac{1}{4}$ sec. 6, T. 9 S., R. 41 E.) is not currently listed in the National Register of Historic Places and, as of this date, has not been nominated to the National Register (Ken Korte, State Historic Preservation Officer, written communication, February 4, 1977). In evaluating site 24BH1524, Fredlund utilized the criteria for nominating a site to the National Register (30 C.F.R. 800.4) and concluded that the site would not qualify (Lynn Fredlund, oral communication).

5 Lahren, however, has recommended that one of the sites he located in the East Decker project area (24BH14) be tested to determine its eligibility for inclusion in the National Register (Larry Lahren, written communication, December 3, 1976). Should mining disturb this site prior to appropriate study and recovery of artifacts, significant archaeological resources could be lost. It should be noted, however, that appropriate study and recovery of artifacts at all known sites would be required prior to mining disturbance (Ken Korte, State Historical Preservation Officer, written communication, Feb. 4, 1977).

6 See response no. 3 above and text revisions on p. 375-377 and on p. 430-432. See also the response prepared to letter no. 7.

7 See p. 611 for a discussion of the statutory requirements that could prevent damage to previously unknown archaeological sites located during project development.

archeological sites are located during project development.
Such actions are required by and in compliance with the
7 Advisory Council on Historic Preservation "Procedures for
the Protection of Historic and Cultural Properties" (36
CFR, Part 800).

Raymond L. Freeman

UNITED STATES GOVERNMENT

Memorandum

TO : Director, U.S. Geological Survey
Reston, VA 22092

FROM : Area Manager, Fish and Wildlife Service
Billings, MT 59101

DATE: Nov. 12, 1976

SUBJECT: Draft of Environmental Impact Statement (DES 76-40) - Proposed Plan of Mining and Reclamation, East Decker and North Extension Mines, Decker Coal Company, Big Horn County, MT

In response to a request from our Chief, Branch of Environmental Coordination, we have reviewed the subject document and wish to offer these comments.

Based on our analysis of the information presented in the draft statement, it appears that all or most of the kinds of impacts to fish and wildlife that would be expected with the Decker Coal Company's proposed expanded Decker Mine operations, have been identified and described.

It is recognized that this is not a new venture into a new area, but rather a substantial enlargement of a mining development that is already underway. Further, although in Montana, the site borders on that portion of Wyoming where new and expanding coal mining operations are no longer unique or as startling as in the recent past. This situation may or may not be reflected in the statement; however, we are left with the general impression that we are being told that the described impacts to fish and wildlife really will not be as severe as presented and that operation, reclamation and mitigation measures will probably be effective in curtailing or restoring much of fish and wildlife losses.

Statements in the preface indicate that both proposed plans are subject to change and may be modified as described under Chapter VIII, Alternatives to the Proposed Action.

The North Extension would be expanded if applications for lease modifications were approved. We would not have anticipated the unexpected anomaly concerning ground-water flow on page 671. However, we would still conclude that the greater the distance of the initial box cut from the Tongue River Reservoir, the less the potential impacts should be.

A decision by the Administrator, Reclamation Division of the Montana Department of State Lands (page 639), unless modified, will result in a significant change in the East Decker mining plan and attitude. We would concur with the philosophy that alluvial stream bottoms and reservoir or lake shorelines should not be buried under mine spoils or fill material. Although alternative mining plans have been presented for

All species of wildlife utilizing areas disturbed by mining activities would suffer unavoidable habitat losses, at least until such time as mining activities cease and mined areas are revegetated (see p. 630). In addition, shortterm habitat loss also would occur in disturbed areas adjacent to the mine boundaries. In the long-term, if mined areas and disturbed lands adjacent to mined areas are returned to their premining condition, wildlife diversity and abundance may approach their premining levels. As noted on p. 575, no conclusive statement can be made at this time as to the reclaimability of the Decker area and hence as to the long-term integrity of wildlife habitat in the area. See also response no. 9 to letter 22.

The explanation of the apparent anomaly whereby ground-water inflow to the pit from the nearby Tongue River Reservoir is less under the alternate mining plan than under the original proposal is given on p. 671.

Montana Department of State Lands has raised objections to potential spoiling into Deer Creek valley (p. 696; p. J-8, Appendix J; and see response 1A to letter 1).

4 the East Decker area, we are not certain that the original plan has been
abandoned.

5 Considering the preceding comments, it would seem appropriate to suggest
that the current draft be considered preliminary and that, after the mining
and reclamation plans are finalized, the statement should be revised and
circulated.

6 The above suggestion is made, more or less, on page 603 of the statement
under item e. Approve mining plan after modification. Our reaction is
that this is a realistic alternative and not one to be proposed and
rejected in an effort to present several alternatives.

7 We are in agreement with the attitude expressed under f. Allow development
of selected areas now under lease. on page 603 also. It might be
considered unrealistic, but we believe that there can be areas within
a lease tract that should not be disturbed. We know this is in conflict
with the philosophy of total mining of a given site. However, we would
agree that it would be less practical to inject such specifications into
a mining plan than it would be to delete or exclude such areas from
leasing before the tracts are offered to the public.


Burton W. Rounds

cc: Regional Director, FWS, Denver, CO (ES)
Director, FWS, Washington, DC (ES Attn: Chief, EC)

- 4 See response 1A to letter no. 1.
- 5 See response 2B to letter no. 1.
- 6 Your comment has been noted.
- 7 Your comment has been noted.



LETTER 9

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
EXECUTIVE TOWER - 1405 CURTIS STREET
DENVER, COLORADO 80202

November 26, 1976

REGION VIII

Director, U.S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir:

This is in response to the Department of the Interior, U.S. Geological Survey/Montana Department of State Lands Environmental Impact Statement (EIS) on the proposed East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana.

The primary concerns of the Department of Housing and Urban Development (HUD) are the effects of a proposed action on the urban environment and housing for people of low and moderate income, including the elderly.

We are extremely concerned about the cumulative socio-economic impacts which will result in the multi-county area affected by the existing and projected coal mining development, particularly in Sheridan County, Wyoming. As it is pointed out in the Draft EIS, in the section on Social and Economic Environment in Volume I and Appendix G in Volume II, the Sheridan, Wyoming, area is the place in which most of the mine employees now live, and the community in which the employees involved in the two new coal developments will reside and require services.

As indicated in the draft statement, increasing costs and "declining adequacy and availability of housing to rent or buy were apparent to most of the residents surveyed and interviewed." These residents also indicated much higher rent than two years ago, and considered this a significant adverse change factor in the community. There was also reported a social service official's opinion that neither adequate nor inadequate units are available, and that "his low income clients have been virtually priced out of the market for even marginal housing."

The disparity in wages which is escalating between mine related wages vis-a-vis the existing lower established wage scales in this area, the housing shortage, and increased costs are of concern to HUD in that these adversely affect the vulnerable population groups of particular concern previously mentioned. A high percentage (16 percent in Sheridan County) of area residents are senior citizens who by virtue of fixed incomes are now impacted by changes within the county and will be even more affected by the cost escalations and lack of alternative housing.

IN REPLY, REFER TO
80E

The sample population appears to be concerned about the general quality of life, and that city and medical services, law enforcement, schools, water and sewer, and the general welfare would be adversely affected.

It appears from the statement that Sheridan, Wyoming will be impacted in several of the categories in the range of our concerns, without the financial benefits which might be utilized to mitigate the adverse effects. Since the state of Montana will receive both extraction taxes from the coal company and income taxes from the employees, interstate financial assistance agreements would certainly be a desirable solution to alleviate the kinds of problems previously addressed.

Although the draft statement addresses the problem of these indirect impacts of existing socio-economic patterns, and projects the possibility for almost 700 needed mine related housing units in Sheridan County by 1978, the draft statement does not address itself to the mitigation of these impacts. The only housing discussed was two small mobile home parks under construction with slow continued development expected. Possible methods of amelioration of these adverse impacts should be thoroughly explored and proposals for their mitigation should be included in the final EIS.

We suggest that a copy of the final statement be sent to the Advisory Council on Historic Preservation, since there are indications that some cultural/archaeological identifications have been made which are of questionable significance. Mr. John D. McDermott, Director of Compliance, 1522 K Street, N.W., Suite 430, Washington, D.C. 20005, would be the correct addressee.

We appreciate the opportunity to comment on the draft EIS on the proposed plan of Mining and Reclamation by the Decker Coal Company in Big Horn County, Montana.

Sincerely,

Sandra K. Woods

Robert J. Matuschek
Assistant Regional Administrator
Community Planning and Development

Interstate financial assistance from Montana to Wyoming would require that the Montana state legislature amend state laws to permit such payments. As the FES points up (p. 631), this action is not likely to occur in the near future. Other, more feasible, methods for mitigating social and economic impacts are discussed on pages 590-611 of the FES.

Sections IV.C.3. and IV.C.5. have been substantially revised in the FES to include a more detailed discussion of measures that could be implemented to mitigate economic impacts and impacts upon social structure and social services. A principle element of this discussion is the listing of possible measures that would at least partly mitigate impacts on housing in the city of Sheridan and in Sheridan County (see p. 607).

A copy of the DES has been furnished to the Advisory Council on Historic Preservation, which subsequently responded in a letter to the Director of the USGS. That letter is included herein, together with appropriate responses. The Advisory Council also will be furnished a copy of the FES.

LETTER 10

FEDERAL POWER COMMISSION
REGIONAL OFFICE
U. S. CUSTOM HOUSE
SAN FRANCISCO, CA. 94111

October 26, 1976

Director
U. S. Geological Survey
National Center
Mail Stop 106
Reston, Virginia 22092

Dear Sir:

We have reviewed the draft environmental impact statement for the Proposed Plan of Mining and Reclamation, East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana, Volumes I and II.

As discussed in the report, the statement was prepared by the U. S. Geological Survey and the Montana Department of State Lands and represents a joint analysis of cumulative environmental impacts of proposed new coal-resource surface-mining development by the Decker Coal Company in the area adjacent to the Tongue River Reservoir in Big Horn County, Montana.

This office's principal concern with changes in land and water resources is the possible effect of such changes on the construction and operation of bulk electric power facilities, including potential hydro-electric developments, and on natural gas pipelines. Since the above noted project apparently would pose no major obstacle to the construction and operation of such facilities, we have no comments on the proposed development.

Sincerely,



GEORGE R. BELL
Acting Regional Engineer

Comments do not require a response.



LETTER 11
United States Department of the Interior

BUREAU OF MINES
WASHINGTON, D.C. 20240

November 11, 1976

Memorandum

To: Director, Geological Survey

From: Director, Bureau of Mines

Subject: Draft environmental statement, Proposed Plan of Mining and Reclamation, East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana

We have reviewed the subject draft EIS and have no substantive comment. It is excellent.

Section 2 of the Energy Conservation and Development Act of 1975 (P.L. 94-163) sets forth national policy to "... increase the supply of fossil fuels in the U.S. ... and to reduce the demand for petroleum products and natural gas through programs designed to provide greater availability and use of the Nation's abundant coal resources. . . ." These mines should contribute directly to these objectives.

W. F. Sullivan
Director

Comments do not require a response.

LETTER 12

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

P. O. Box 2417
Washington, DC 20013

6200-11 (1/69)

8400



Director, U.S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir:

We have reviewed the draft environmental impact statement for the Proposed Plan of Mining and Reclamation for the East Decker and North Extension mines, Decker Coal Company, Big Horn County, Montana, transmitted with your letter of October 8 (Ref. EGS-MS760).

Forest Service land that could be impacted by this project is the one-half million acre Ashland Division in the Custer National Forest located some 30 miles northeasterly and accessible by gravel road from the existing Decker Mine.

Due to improved access routes being tied to Sheridan, Wyoming, approximately 25 miles to the south of Decker, primary impacts have and, with this project, will continue to be in that direction. Even the secondary recreation use occurs primarily on the Bighorn Forest, west of Sheridan, rather than on the Custer. Since all of the workers live in Sheridan and commute to the mine, residence rights are in Wyoming rather than Montana.

Decker Coal Company has made a noteworthy and consistent effort to restore mined lands to productivity and otherwise comply with State and Federal legal requirements. In reviewing this proposal, we believe the Company will continue to do its part.

The environmental statement appears to adequately cover the anticipated impacts as well as consider viable alternatives.

Sincerely,

R. Max Peterson
R. MAX PETERSON
Deputy Chief

Comments do not require a response.

LETTER 13

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

P. O. Box 970, Bozeman, MT 59715

November 29, 1976

Director
U. S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir:

Re: Draft Environmental Statement DES 76-40
Proposed Plan of Mining and Reclamation for the East Decker
and North Extension Mines, Decker Coal Company in Big Horn
County, Montana.

We have reviewed the above environmental statement and find that it adequately addresses those items that are of concern to the Soil Conservation Service. We find no conflict with any on-going or planned SCS programs or projects and have no comments regarding this impact statement.

We appreciate the opportunity to review the environmental impact statement on this proposed project.

Sincerely,

Van K Haderlie
Van K Haderlie
State Conservationist

cc: Administrator, SCS, Washington, D. C.
Coordinator of Environmental Quality Activities, USDA, Wash., D. C.
Council on Environmental Quality, Wash., D. C. (5)

Comments do not require a response.





LETTER 14

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

REGION VIII

FEDERAL OFFICE BUILDING
19TH AND STOUT STREETS
DENVER, COLORADO 80202

November 18, 1976

OFFICE OF THE REGIONAL DIRECTOR

Mr. Henry W. Coulter
Acting Director
U. S. Geological Survey
National Center, Mail Stop 108
Reston, Virginia 22092

Dear Mr. Coulter:

Thank you for the opportunity to review the draft Environmental Impact Statement on the proposed plan of Mining and Reclamation for the East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana.

It appears that the impacts expected to result from the proposed project and reasonable alternatives thereto have been adequately addressed.

Comments do not require a response.

Sincerely yours,


Rulon R. Garfield
Regional Director

cc:
Office of Environmental Affairs
HEW, Washington, D.C.

Council of Environmental Quality
Washington, D.C. (2 copies)





ATTACHMENT TO LETTER 15
STATE OF MONTANA



DEPARTMENT OF STATE LANDS

HELENA 59601 (406) 449-2074

STATE CAPITOL

STATE BOARD OF
LAND COMMISSIONERS
THOMAS L. JUDGE
GOVERNOR

DOLORES COLBURN
SURY OF PUBLIC INSTRUCTION

FRANK MURRAY
SECRETARY OF STATE

ROBERT L. WOODDAHL
ATTORNEY GENERAL

E. V. SONNY OMHOLT
AUDITOR

November 30, 1976

MEMO

TO: Director
U. S. Geological Survey
National Center
Mail Stop 108
Reston, VA 22092

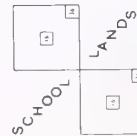
FROM: Brace Hayden
Environmental Coordinator

SUBJECT: Decker D.E.I.S. Comments

Leo Berry, Jr.
XXXXXXXXXXXX
Actg. Commissioner

These comments were submitted to the Acting Commissioner, Montana
Department of State Lands instead of to the Director, U.S.G.S.
Please enter them in the record. Thanks.

Enc.



A
RESOURCE
FOR THE
PRESENT

AN
OPPORTUNITY
FOR THE
FUTURE



LETTER 15

MONTANA DEPARTMENT OF COMMUNITY AFFAIRS

Capitol Station, Helena, Montana 59601

Thomas L. Judge
Governor

November 26, 1976

Mr. Leo Berry, Jr.
Acting Commissioner
Montana Department of State
Lands
Capitol Station
Helena, Montana 59601

Dear Leo:

We have reviewed the draft environmental impact statement for East Decker and Extension Mines, Decker Coal Company, Big Horn County, Montana and have no comments to offer.

Sincerely,

Barbara Garrett
Planner
DCA/Division of Planning

BG/ke

No response is required.

LETTER 16

Anthropology

University of Montana
Missoula, Montana 59801
(406) 243-0211

November 22, 1976

Director, U. S. Geological Survey
National Center, Mail Stop 108
Reston, Virginia 22092

Attn: Herbert G. Stewart, Special Asst., Environmental Analysis

Re: Draft, Environmental Impact Statement, Proposed Plan of Mining and
Reclamation East Decker and North Extension Mines, Decker Coal Co.,
Big Horn County, Montana.

Gentlemen:

For the Department of Anthropology, University of Montana, I
would like to thank you for the opportunity to comment on this draft.
My observations and questions are confined to those sections dealing
with archaeological sites.

No sites were nominated for inclusion in either State or Nat-
ional Registers. I note that in Volume I, page 288, it is stated that
"none of the archaeological sites found within the proposed East Decker
and North Extension areas appears to be of major importance." Similar
negative statements about the importance or significance of the sites
can be found on pages 355, 409, 470, 588, 629, and 684. The justifica-
tions for these statements are never given; the reader is never told
why sites are considered not important. What considerations and criteria
were used for the evaluations?

In Volume II, Appendix H, some statements have suggested questions
to us:

- 2 page 3 -- Were the Bureau of Land Management lands ever surveyed?
Results?
- 3 page 6 -- "This testing will be continued." Results? What criteria
were used in determining that a site should not be tested,
e.g., 24BH1510?
- 5 page 10 -- Was that part of site 24BH1517 located on BLM lands ever
surveyed?

- 1
- 2
- 3
- 4
- 5

See text revisions on p. 297-303, 375-377, 430-432, 494-495, 611-
615, and 646. See also revisions to Appendices H and I.

An archaeological survey of Bureau of Land Management (BLM) lands in
the North Extension area is included in Fredlund's Final Report
(1976). An archaeological surface reconnaissance of these BLM lands
was also made by Lahren (1976) (see text revisions on p. 297-303).
Fredlund and Lahren identified a total of four sites on or partially
on BLM lands within the North Extension area.

The testing to be continued referred to in this comment involves
proposed radio-carbon dating of heat cracked or crazed quartzite
cobbles noted at site 24BH1524. Fredlund noted in her Final Report
(1976) "*** Examination and testing indicated that the ridge crest
had been washed through erosion causing considerable redistribution
of the heat-fractured rock and totally washing out any charcoal
which may have originally been present***" As a result, no carbon
was found and no radio-carbon dating was possible for site 24BH1524.

The need for subsurface testing at a site was determined by the
amount of local deposition of unconsolidated materials. Subsurface
testing was performed at all sites where apparent sediment deposition
had occurred (L. Fredlund, oral communication).

Site 24BH1517 was adequately surveyed, tested, and recorded by
Fredlund after receiving a permit from the Archaeological Division
of the National Park Service. Results are given on p. H-16 and H-
17, Appendix H.

6 page 17 - Site 24BHL524 "will be tested." Determination?
7 page 19 - Is Attachment A a listing of all of the lands that
were surveyed?

We appreciate being able to participate in the review process.

Yours very truly,



Dee C. Taylor
Professor, Anthropology

cc: Mr. Leo Berry Jr.
Acting Commissioner
Montana Department of State Lands

6 See response to comment no. 3 above.

7 Attachment A (p. H-19, Appendix H of the DES) included a listing of all lands surveyed within the East Decker and North Extension areas. Lands administered by the BLM were not surveyed and, therefore, were not included in that listing. Fredlund's Final Report (1976) includes a survey of all BLM lands in the proposed project areas.



LETTER 17

State of Wisconsin / DEPARTMENT OF NATURAL RESOURCES

Anthony S. Earl
Secretary

November 26, 1976

BOX 7921
MADISON, WISCONSIN 53707

IN REPLY REFER TO: 1600

Director
U. S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir:

Re: Draft Environmental Impact Statement for Proposed Plan
of Mining and Reclamation, East Decker and North Extension
Mines, Decker Coal Company, Big Horn County, Montana

We have completed our review of the subject document and offer these comments:

Page 74, Transportation and marketing of the coal - The Department's interest in this mining and reclamation proposal relates primarily to the ultimate destination of the coal and the environmental consequences associated with its transport. We understand that the coal bound for Detroit Edison would be transshipped at the ORBA facility in Superior, Wisconsin. We are also interested in learning whether or not the coal bound for Chicago would be barged on the Upper Mississippi River. Discussion of the secondary impacts arising from the shipment of the coal to Chicago and Detroit, as well as Texas, has been omitted from the Draft EIS and should be presented in the Final EIS.

This section and section III.C.15. on page 471 should be expanded to include information on the proposed routes and modes of transport from the mines to the receiving power plants. The need for and possible locations of additional bulk handling facilities along the proposed transportation network should be analyzed.

We thank you for the opportunity to review and comment on this draft statement and would appreciate receiving a copy of the final document when it is completed.

Sincerely,
Bureau of Environmental Impact

James R. Hunt
James R. Hunt
Director

All coal from the proposed Decker mines destined for use by Detroit Edison would be transported by unit train to the Superior Midwest Energy Terminal (also known as the ORBA facility) at Superior, Wisconsin and shipped via the Great Lakes to the Detroit area (see text revision on p. 501). No coal bound for the Chicago area from the proposed mine would enter Wisconsin (p. 501-502).

See text revisions on p. 499-504.

See text revisions on p. 78 and p. 501-502. All coal from the proposed mines would be transported directly to power-generation plants or to existing transshipment facilities at Superior, Wisconsin and Havana, Illinois by unit trains. No additional transshipment or bulk-handling facilities are needed or proposed.

1

2

3

LETTER 18

November 18, 1976

The Sheridan County Commissioners on behalf of their constituents in the Wyrno area, wish to address the problems of the increased rail traffic. More particularly, the increase in numbers of unit trains.

The question being raised here by Commissioners is whether or not the impact of double the number of coal trains has been assessed, and the need to review the time element on the blocking of Highway 336 in what is known to the railroad as the Dutch Crossing.

The proposed new mines as well as the other coal mines contemplated in the area give rise to serious questions in this regard in future years as well as currently.

Sheridan County Commissioners have met on several occasions with members of the Wyrno community to discuss these problems, and we have, and wish to present, a letter as evidence of concern of these citizens about the railroad activity in that particular area. A list of grievances include: hazardous crossing conditions, emergency vehicle and school bus tie up at crossings, inadequate fencing or poor maintenance of existing fences, weed control problems along the railroad right of way, increased fire hazards that must be attended to by County Fireman and County Fire Districts, to just mention a few.

Sheridan County has plans to pave and upgrade the Lower Prairie Dog Road to the Montana line by means of a Wyoming Coal Tax Grant. This improvement will, no doubt, increase traffic on this road to and from Decker by workmen there, as it will be a short route to their job site.

There are railroad crossings on this road which could be hazardous as

See text revisions on p. 499-504 for a discussion of the increase in train traffic that would occur over the Decker spur line if the Decker Coal Co. proposals are implemented. The task force estimates (p. 501) that at full production, unit train traffic from the North Extension, East Decker and West Decker mines would block the crossing on Wyoming Highway 336 northeast of Wyrno (Dutch crossing) for approximately 57 minutes per day. This represents an increase of about 20 minutes per day over the period that the crossing is currently blocked by train traffic from the West Decker mine. The task force also estimates (p. 503-504) that within the next decade approximately 200 trains per week, including both loaded outgoing trains and returning empty trains, would cross Wyoming State Highway 336 northwest of Wyrno, given the projected coal production in the area that would be serviced by the Decker spur line. If such estimates prove to be accurate, the crossing northeast of Wyrno would be blocked on the average of about 2½ hours per day.

See text revisions on p. 499-500 for a description of the cumulative impacts that are expected to occur from increased rail traffic.

Your comment has been noted. See text revisions on p. 499-500 and also correspondence from Burlington Northern Inc. to the Powder River Basin Resource Council in Appendix M. Impacts to crossings on the Lower Prairie Dog Road in Wyoming would be essentially the same as those described for Dutch crossing. The traffic on this road, however, would probably be somewhat less than on Wyoming Highway 336.

3 they are not controlled by signal lighting.

These added problems to a County that does not benefit from the coal tax base in Montana are serious to a County that does not now have an adequate tax base to service the people who live in Sheridan County, Wyoming and work in Montana. Taxes on retail sales and home ownership will not handle the situation.

4
5 Corporate and Government responsibility must be met in regards to the public safety and welfare of Wyoming citizens.

BOARD OF COUNTY COMMISSIONERS
Sheridan County, Wyoming

William J. Truitt
Chairman

W.B. Finch

4 Your comment has been noted. See p. 477-479 for a description of the changes in governmental operating expenses and revenues should the proposals by the Decker Coal Co. be approved.

5 Your comment has been noted.

ATTACHMENT TO LETTER 18

November 15, 1976

County Commissioners
County Court House
Sheridan, Wyoming 82801

Dear Mr. Laya, Mrs. Rice and Mr. Firth:

The Wyno Community Council has met with your group on four separate occasions to discuss local problems created by increased traffic on the Burlington Northern Railroad.

The concerns of the Wyno citizens are as follows:

1. Increased rail traffic which has rendered most grade level railroad crossings into a hazardous condition.
2. Antiquated fencing regulations and poor maintenance of existing fences has materially increased time lost to the ranch operators and chances for increased stock losses.
3. The lack of perennial weed control has deteriorated adjacent agricultural lands and annual weeds are becoming a great problem.
4. Fire prevention measures as practiced by the Burlington Northern Railroad are minimal and are in bad need of being up-graded.

Therefore, the Wyno Community Council proposes that the County Commissioners take the following actions on the various problems:

Under Item 1, that the county work with the Wyoming Highway Department and the State Public Service Commission to obtain a separated grade crossing on State Highway No. 33, and at the very least install signal lights on the more hazardous county road crossing. The latter is especially critical on roads frequented on a twice daily basis with school bus traffic.

Under Item 2, that the county work with the Wyoming Public Service Commission and local legislative members to up-grade railroad fencing specification and maintenance criteria.

Under Item 3, that the County Commissioners, through the Sheridan County Weed Board, establish a meaningful eradication program and compliance check system for both perennial and annual weeds.

Under Item 4, that the County Commissioners through the Sheridan County Fire Board establish a rather rigid time schedule for the mechanical tillage of the fire breaks and that some norm be established for the control of the more flammable weed species. See attached P.S.C. General Order No. 31.

Respectfully submitted,

Lenard Brownell

Chester Hape
Sheridan Burgess
Mrs. Vera Grady
Gerald Costel

M-86

LETTER 19

SHERIDAN AREA PLANNING AGENCY

P.O. Box 652

Sheridan, Wyoming 82801

November 23, 1976


Director, U.S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir:

The enclosed statement is offered as a comment on the draft Environmental Impact Statement on the proposed East Decker and North Extension coal mines in Big Horn County, Montana. Your serious consideration of these comments would be greatly appreciated.

Sincerely,

SHERIDAN AREA PLANNING AGENCY


John McWilliams
President

JM:kpg

Enclosures:

In response to publication of the draft Environmental Impact Statement for the proposed plan of mines and reclamation, East Decker and North Extension mines, I should like to submit the following statement as comment.

My name is John McWilliams. I am president of the Board of the Sheridan Area Planning Agency, and I am also a member of the Sheridan County Planning Commission. As such, I am very closely connected with efforts being made to prepare the Sheridan area for the impact from energy development; an impact we are already experiencing. Accordingly, I will address my comments only to those portions of the EIS which deal with the social and economic effects of the Decker proposal upon our community, and I will assume the "reasonable" accuracy of the projected effects of this expansion upon Sheridan. It should be noted, however, that the time lag between the preparation of the reports and publication of the EIS has resulted in some disparity between the figures used in the studies and figures currently used locally in planning.

Taking then, the EIS at face value, it is made very explicit immediately that despite the benefits of this development to the nation as a whole, it will have a significantly detrimental effect upon the Sheridan community.

(Summary, frontpiece, adverse, unavoidable environmental impacts)

3. (F) State and local Montana governments are calculated to have sizable revenue surpluses from the proposed mines whereas Wyoming governments would experience deficits. Quick resolution of this problem is unlikely because of the unprecedented coordination and cooperation necessary to transfer funds from one of these States to the other.

(G) Mining-related population growth in the Sheridan area would cause at least short-term impacts on housing availability and cost. Lag would occur in the ability of Sheridan to provide adequate community services to an increased population.

The statement develops the effect of this impact at much greater length and in detail, and the inescapable conclusion is that socially and economically

the net effect of this proposed expansion will be a serious social deficit for the people of this community and a very serious financial deficit for all local governments and social agencies (Tables 52-56.) If this situation is correctly projected for Sheridan, it will also be true for many, if not most, communities faced with impact from energy development; at least in the initial stages of development.

I understand why it should be outside the scope of the EIS to address the effects of development other than the Decker proposal. I am also sure you understand that our community must prepare, not only for Decker, but for other coal development as well. In spite of the difficulties involved in assessing what development will begin, and where, and when, there are very positive indicators that additional development will indeed come, and we will experience the effects of those also. Again, most of these developments promise to have the same deficit relationship to our economy as does Decker Coal. The effect of any particular proposal to mine must therefore be viewed by us as part of a larger, and even gloomier picture, unless mitigation measures are developed.

The discussion of mitigation measures clearly indicates that the adverse effects of most social and economical impact problems can not be mitigated without money. Other measures, such as land use controls, development regulations, and advance planning are being developed locally as rapidly as possible. Any solution to the problem of increasing needed revenues is summarily and somewhat cavalierly dismissed on page 575, paragraph 3:

The lag in providing community services to the growing population, like the lag in housing supply, appears to be inevitable. Therefore, adverse, unavoidable impacts on the quality and breadth of community services would occur if the proposals are implemented. A viable solution to the problem of how to pay for increased social costs in Wyoming when coal revenues generated by expanding Decker mining activity accrue to Montana has not been reached.

and local citizen concern that development pay its way is characterized as

Sections IV.C.3 and IV.C.5 have been substantially revised in the FES to include a more detailed discussion of possible measures to mitigate economic impacts and impacts upon social structure and social services. More detailed suggestions for solutions to such impact problems, and especially suggestions that entail increasing tax revenues, will have to come from long-term, cooperative, and intensive studies by tax experts, planners, and political officials. This environmental statement is not a substitute for that planning process; it is only one of several tools available to state and local governments in reaching solutions to the stresses that would be placed on existing social and economic structures. As stated on p. 590-611, the city of Sheridan and other Sheridan area communities have begun to build a framework for problem solving through the efforts of the Sheridan Area Planning Agency.

It was never the intent of the task force to dismiss mitigating measures for social and economic impacts in a cavalier manner. The task force wished to make it clear, however, that regardless of Federal or State monies available to mitigate socioeconomic impacts, such large scale changes as those that would be caused by the proposed new Decker mines would adversely impact human relationships and organizations.

somewhat naive. The net effect upon the public sectors of the Sheridan area, would seem to be that we are destined to sacrifice, or be sacrificed, for the additional energy development.

To assist us in solving this difficult situation, I ask that the EIS directly address the problem. The argument that the development of solutions lie outside the scope of any EIS begs the question "Where do we start?" Surely the solutions are the responsibility of us all - the USGS, the Montana Department of State Lands, and all involved agencies, as well as local officials who are otherwise condemned to watch their community deteriorate, and of local citizens who must see their taxes rise and the quality of their community and their life decline.

As a starting point, I propose the following as a foundation from which to build a solution.

1. Developing our energy resources is in the National Interest; that is, in the interest of every person in the United States. The costs of developing this energy should therefore be borne equally by everyone.
2. Only the Federal government has the legal, jurisdictional and taxation authority to cope with the problems of inequities created by state and sub-state political subdivisions; therefore, the solution must be handled at the Federal government level.

I, therefore, propose a Federal tax not just on coal but on all extractive energy. The tax should be equitable between energy sources in order not to create any pricing inequities between competitive sources. It should be sufficient to create a fund adequate to cover costs of local and regional impact created by development of energy sources; including imbalances already created by past development. Such a fund would be administered by an existing department of government, such as Interior or FEA.

Local governments and agencies of impacted areas would have both individual

and joint access to this fund; monies from which would be available as direct grants, low interest or interest-free loans, and long term entitlements (to cover increased operating costs.) Such a program of financial assistance would take into account the greater abilities of some communities (through increases in their tax base) to finance the local needs, and the lesser abilities of others (such as Sheridan County) which serve as "bedroom" communities to development outside their boundaries, and also the needs of all communities during the lag time between impact and an increase in the tax base.

In other words, the Federal government would develop an equalization program to finance costs of impact: These costs would be internalized in the costs of all energy (as reclamation costs are now internalized for strip mining) and made available according to need. The size of the fund, like the amount of tax, will have to be developed by economists more skilled than I.

3 But the principle will assure that everyone, in the National Interest, share the costs of developing energy for the National Interest. The idea that the few must sacrifice for the many is not only unnecessary, but if in fact the energy in the West is developed any where near its potential and the problem of funding is not addressed and solved, this part of the United States will indeed become the "National Sacrifice Area." To judge by the number of tourists from the energy-consumptive East who travel each year to visit us, we may have something out here that the rest of the country needs, and I do not mean coal. To destroy that intangible "something" in the name of energy development may not be in the National Interest **either**.

Develop our energy we must. Most of our impact problem can be mitigated with money. You people who are responsible for assessing the effects of impact are as responsible as anyone is to see that solutions are found. If this proposal is not feasible, and there may be good reason why it is not, I should

4 Your comment has been noted.

2

like to know them. If it, or some similar proposal is indeed feasible, then
4 your EIS is a good place to start, and you could encourage all the regulatory
agencies involved to begin the political processes needed to accomplish the
enabling Federal legislation.

John C. McWilliam

LETTER 20

SHERIDAN COUNTY CHAMBER OF COMMERCE

R E S O L U T I O N

The following Resolution was presented, approved and authorized by the Board of Directors on the 17th day of November, 1976:

BE IT HEREBY RESOLVED: That the Sheridan County Chamber of Commerce, representing the Sheridan, Wyoming, trade area, wishes wholeheartedly to endorse the mining applications and environmental statements of the Decker Coal Company. We believe that past endeavors of the Decker Coal Company in land reclamation and participation in this area's many good community programs speaks very clearly of its interest and good will to all peoples living in the Sheridan, Wyoming, trade area.

BE IT FURTHER RESOLVED: That the Sheridan County Chamber of Commerce appreciates the individual participation of many Decker Coal employees in school, church, scouting, service clubs and other community activities of this area, which is indicative of the high quality of the people employed by said company.

BE IT FURTHER RESOLVED: That although the Sheridan, Wyoming, trade area, due to its location, will primarily receive all of the impact created by the additional Decker Coal Company mining applications, it is understood that federal and state funds will be available in the near future for such impact and this area will receive large sums under the Impact Distribution Formula to cover the problems which will be encountered as a result of increased mining.

BE IT FURTHER RESOLVED: That because of its location the Sheridan, Wyoming, trade area will receive increased business created as a result of additional mining under said applications and such business will be most welcome by the business community and the population in general.

BE IT FURTHER RESOLVED: That the Sheridan County Chamber of Commerce recommends that said mining applications and environmental statements be approved by the State and Federal Governments.

SHERIDAN COUNTY CHAMBER OF COMMERCE

By: 
Stanley Olsen, President

The resolutions are acknowledged.

LETTER 21

Decker Coal Company

One Thousand Kievit Plaza
Omaha, Nebraska 68131

(402) 342-2052

November 24, 1976

Mine: Decker, Montana

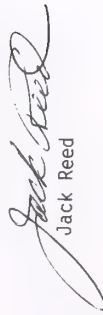
Director, U.S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir:

Comments on the draft Environmental Impact Statement are attached.

Very truly yours,

DECKER COAL COMPANY


Jack Reed

JR/hc
Attch.

DECKER COAL COMPANY
Draft Environmental Impact Statement

1. The final statement should reflect the proposed rule changes 26-2.10(10)-S10310(1)(b) before the State of Montana, Board of Land Commissioners, concerning the placement of problem soils and overburden in mining and reclamation operations.
2. Page G-110 of the Appendix, paragraph 1, second sentence. Decker Coal Company does not have any record or knowledge of an ad offering employment with Decker Coal Company being run in a Chicago paper.
3. Page 532, line 6, change "a" to "no".
4. Page 35 (b) - Topsoiling.
4. Topsoiling is not placed in two applications. One application followed by discing and seedbed preparation has proved successful.
5. Page 42 (b) - Access Road.
5. First sentence should read, "Access to the East Decker mine would be provided by construction of 3.6 miles of surfaced roadway".
6. Comments on Wildlife section:
 - i. Summary of adverse, unavoidable environmental impacts (pg. 1) - Part E:

"Antelope and sage grouse would be severely affected at least for the short-term". "Severely" should be struck from the sentence. All the literature I've been able to get hold of, plus 10 years of work around uranium mines and coal mines in central, northeastern, southeastern, and southwestern Wyoming, lend no support at all to the flagrant and irresponsible assumption that mining activity automatically precludes use by wildlife. Witness antelope and sage grouse activity around West Decker, bentonite mines in the Big Horn Basin, Colony area and Kaycee area, uranium mines in the Shirley Basin and Gas Hills areas, coal mines in the Hanna-Rawlins, Gillette, Sheridan, Casper, Glenrock, Rock Springs, and Kemmerer areas. None of these mines has had any measurable Tet alone, severe impact on antelope.
 - ii. Page 218 - Part C: Population characteristics
Wording should be changed so it doesn't sound like there are 1,693 mule deer in the area.
 - iii. Page 219 - Part B: Use of habitat types
Antelope - The last paragraph of this part (pg. 220) should be left

Proposals, which commonly are extensively revised before adoption, are not applicable until they become law and are enforceable. In this case, however, it should be noted that MDSL rules and regulations adopted pursuant to the Montana Strip and Underground Mine Reclamation Act require that:

"An operator shall show where the overburden and parting strata materials are to be placed in the backfill. Materials which are not conducive to revegetation techniques, establishment, and growth shall not be left on the top or within eight (8) feet of the top of regraded spoils or at the surface of any other affected areas. The Department may require that problem materials be placed at greater depth. (MAC 26-2.10(10)-S10310(1)(b))."

In August 1975, the Northern Plains Resource Council, Tri-County Ranchers Association, and McCone County Agricultural Association petitioned the Montana Board of Land Commissioners to amend the above rule and to appoint a committee of nine persons to draft a proposed rule specifically dealing with the handling of sodic spoils. Subsequently, the Board authorized that a technical advisory committee be formed and approved the Department's recommendations for the composition of such a committee.

After several committee and subcommittee meetings at which Departmental staff were present, the technical advisory committee submitted to the Department the following proposed rule change.

PROPOSED RULE TO REPLACE 26.2.10(10)-S10310(1)(b)

- b) An operator shall show how overburden and parting strata will be placed by mining and recontouring operations, and to what depth topsoil will be redistributed. Spoil materials which are acid producing, toxic, undesirable or creating a hazard shall be buried under adequate fill:
- i) Spoil materials which, due to adverse sodium-related physical characteristics are undesirable as a plant growth medium, shall be covered with at least two (2) feet of suitable plant growth material; provided, however, that if naturally occurring conditions will not provide at least two (2) feet of useful soil material, the Applicant shall submit an alternative plan for approval by the Department. In cases where spoils pose severe physical problems including hydraulic conductivity and erosion, the Department may specify burial depths greater than two (2) feet, slopes less than 5:1, or other treatments.

out of the final EIS. After three years of work and the past two years being specifically directed toward identifying antelope use in the Deer Creek flood plain, we still have yet to document any use at all of the area by antelope at any time of the year. Benches on either side are utilized to some degree - nothing has been recorded in the flood plain though.

8

iv. Page 224 - Part B: Use of habitat types
Sage grouse - Because of the low observability of sage grouse, the % use reflected in this paragraph is a reflection more of the observability of the bird rather than its actual habitat preference.

9

v. Page 226 - Part B: Use of habitat types
Sharp-tailed grouse - Again, the use figures are indicative of observability factors rather than use preference.

vi. Page 229 - Section 9: Great Blue Heron and Double-crested Cormorant
Rookeries of the two birds are not segregated by 500 yards, as stated. In many cases both species are nesting in the same tree.

10

vii. Page 231 - Section 12: Osprey
Foot note No. 2, "The number of young osprey fledged in 1975 was three, not two, according to records at the Montana Fish & Game Dept. Three birds were hatched, one died in the nest, two were fledged."

11

viii. Page 233 - Section 17: Threatened and endangered species
Last sentence of the paragraph should be changed to read, "The whooping crane may be a rare visitor to the Tongue River Reservoir during migration". No confirmed sightings have been made.

12

ix. Page 345, second paragraph, second line:
"Pheasants, antelope, and white-tailed deer utilize the poplar-willow areas as escape and resting cover"
Not true. We have seen no antelope or white-tailed deer in the area for the past three years. Antelope avoid cover rather than seek it. Limited visibility is probably one of the main factors in explaining the reason antelope have not been recorded using the Deer Creek bottomland.

13

x. Page 349 - Section 3: Antelope
Second paragraph, "In addition, the integrity of Deer Creek valley as a fawn rearing area would be jeopardized, etc." It should be pointed out that the popular belief that the Deer Creek area is an important fawn rearing area is purely speculation. Three years of observation has yet to turn up a single instance of use in the bottomland.

14

ii) If spoils contain levels of chemical constituents which are acid producing, toxic to plant growth, or, when taken up by plants are toxic to animals consuming those plants, or are otherwise hazardous, the Department shall require burial of toxic materials at depths to insure desirable vegetation, limited leaching by water, and protection of groundwater.

1 In November 1976, a hearing was held on the proposed rule change at which supporting and opposing testimony were presented. Subsequent to the public hearing, MDSL staff met again with the technical committee to discuss potential problems and solutions regarding sodic spoils, but as of March 1977, no decision has been reached by the Department as to whether it should adopt, modify, or reject the Technical Advisory Committee's recommendation. Reference to the proposed rule change is made on p. 530 of the FES.

The Chicago ad concerning employment at the West Decker mine was reported by two city of Sheridan citizens interviewed by the Institute for Social Research (1975) during the summer of 1975 (see p. 274-275). The Institute reported the ad as the basis of a belief held by local residents that accounted for some of their attitudes toward the effect of the proposed mine expansions on Sheridan unemployment levels.

3 See text revisions on p. 568.

4 See text revisions on p. 38.

5 See text revisions on p. 46.

6 The well-being of antelope and sage-grouse populations is closely tied to sagebrush communities. When these plant communities are removed by strip mining, antelope and sage grouse are deprived of essential portions of their food supplies, winter habitat, and, for sage grouse, nesting habitat. Without the sagebrush plant community, the life cycle of these two species is severely affected in the short term.

7 See text revision on p. 226.

8 Antelope does and antelope fawns have been observed in the Deer Creek valley and on the adjacent benches by MDSL staff members. Furthermore, Decker Coal Co.'s antelope distribution map for the summer of 1975 shows high use by antelope in areas immediately adjacent to Deer Creek valley and also shows a few sightings made in the valley itself (maps submitted to MDSL, August 16, 1976). Jim Wambaugh of the Montana Fish and Game Department, however, made no observations of antelope in Deer Creek valley during the 2 months he spent in the Decker area during the summer of 1975.

xi. Page 349 - Section 4: Sage Grouse
It is purely sentimental speculation which leads one to say destruction of the strutting ground will "lead to a reduction or elimination of the population."
Research into the literature available and practical experience with sage grouse ecology indicates that there has never been a documented case of the destruction of a strutting ground causing the reduction or loss of a sage grouse population. On the contrary, there have been several cases cited where natural grounds have been destroyed and the birds either moved to surrounding grounds or established new grounds. In many cases birds have voluntarily abandoned century old grounds to establish new grounds in man-made power line rights-of-way. The section should be rewritten (with references) to reflect true biological facts rather than sentimental beliefs and speculation.

xii. Page 592 - first paragraph.
Whole paragraph should be eliminated or reworded to express biological truths. Sage grouse will not be affected by the loss of the strutting ground alone. They will most likely establish a new ground nearby or use already existing grounds in the vicinity. Also technological knowledge is increasing rapidly. Witness: EGS's success in artificially establishing a sharp-tailed grouse lek on reclaimed land near Colstrip.

- 8 Professional wildlife biologists who have conducted research on the pronghorn antelope believe that a reason for antelope sightings made in and adjacent to the Deer Creek valley during the summer months is the palatable, highly proteinaceous forage found in the valley (see p. 310).
- 9 It may be partially correct that the percent use reported is a reflection of the birds' observability. However, population levels within the proposed mine areas are not given to high bird observability. Moreover, the percent use for the various habitat types compares favorably with that reported in other studies (Knapp 1975a, 1975b).
- 10 See text revision on p. 237. Although great blue herons and double-crested cormorants are not generally observed nesting together, both species have been observed nesting in the same trees in the Decker area.
- 11 See text revision on p. 239.
- 12 See text revision on p. 241.
- 13 See text revision on p. 366. Neither antelope nor white-tailed deer have been observed in poplar-willow areas of the Deer Creek valley by either MDSL staff or staff of the Montana Fish and Game Department. Pheasants, however, have been observed in these areas. It should be noted that white-tailed deer have been observed in the willow-poplar habitat along the Tongue River near its confluence with the reservoir (fig. 53).
- 14 See response to comment 8 above.
- 15 See text revision on p. 370.
- 16 See text revision on p. 649.

Tri-County Ranchers Association

Birney, Montana 59012

TESTIMONY OF THE TRI-COUNTY RANCHERS ASSOCIATION CONCERNING THE DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE PROPOSED PLAN OF MINING AND RECLAMATION FOR EAST DECKER AND NORTH EXTENSION MINES. DECKER, MONTANA NOVEMBER 17, 1976

My name is Ed Malenovsky. I am President of the Tri-County Ranchers Association, an affiliate of the Northern Plains Resource Council in the Birney-Decker area. My comments today represent the views of the Tri-County Ranchers on the impact statement for Decker Coal Company's proposal to open a major strip mining complex around the Tongue River Reservoir.

Although we have not attempted to go through, line by line, every subject covered in the impact statement, two major areas are of immediate concern: the social and economic section and the section on the mining plan itself.

SOCIAL AND ECONOMIC ASSESSMENT

In the social and economic section of the Appendices, under "Development Assumptions," the very first assumption made is incomplete and untrue. The section reads: "The nature of a local economy, be it one of development and growth, stagnation, or decline, is one variable which will affect population change." (Pg. G-1) It cannot be denied that growth or stagnation and/or decline affect population change. However, the statement implies that a stable economy is the same as a stagnant or declining one. Neither the economic facts of the area, which is agricultural, nor the views of the residents agree with that assumption, according to the questionnaire concerning expansion of the Decker Mine (Pg. G-189 -- G-204).

2 While a stable agricultural base has not been a "billion dollar baby"

The sentence quoted from p. G-1, Appendix G is not a developmental assumption of the demographic study (Fitzpatrick, 1975) that was utilized in the impact statement. Instead, this sentence refers to the fact that population migration is related to the availability of jobs. The actual assumption being referred to here (p. G-1, Appendix G) states: "Population change is the product of birth, death and migration."

- 1
- 2 Your comments have been noted.

to the area, neither does it cost the community more than it puts into it.

Unemployment in the area has been relatively low prior to development - -

- 2 4.4 percent in April 1970 (Pg. G-17). While incomes were not extremely high, local merchants prospered and there was a good balance among services available, costs of those services and population. The Indian unemployment situation is not good, but we question whether Decker Coal Co. employs many
- 3 Crows or Cheyennes or finances job training programs aimed at bringing employment to Indians.

Another assumption the impact statement seems to make is that people are

- 4 better off if the average income level is higher and that the more mining occurs, the better off people will be because of declining mill levies. However, it is misleading to measure the well-being of an area this way. First, mill levies are still considerably higher in Big Horn County than they were before mining began. Second, mill levies and personal income are only part of the picture. They cannot be used to measure whether a person is better or worse off. Mining itself causes a tremendous change in the social and economic structure because it means industrialization of an area that was formerly

- 5 agricultural. While dollar costs cannot be placed on that change, it must not be ignored. In addition, the change places huge pressure on existing services (Pg. G-189 -- G-204). Also, in an agricultural area rural residents demand little in the way of services in comparison with urban people. Therefore as mining increases, the population of people in cities increases in proportion to those in rural areas, followed by requests by residents for more government services, with a corresponding increase in local government costs.

- 6 Assumption number K on page G-6 outlines another major complaint about

Decker Coal Co. is an Equal Opportunity Employer and a financial contributor to the Sheridan College Coal Technology Program. Company records show that Indians are employed at the West Decker mine at this time.

Per capita personal income is a widely used indicator of economic well being. It is not a perfect index because it does not incorporate changes in the cost of living and equates well-being with money income. Certainly, the residents of the Decker vicinity enjoy considerable benefits which are not easily measured in terms of dollars. Money income, nevertheless, is the one measure which is readily available and easily understood (see p. G-24, Appendix G).

The following relevant data on mill-levy rates were abstracted from table G-17 (p. G-34, Appendix G):

| <u>County/fiscal year</u> | | <u>Mill levy for county purposes and county-wide school levies</u> |
|---------------------------|--|--------------------------------------------------------------------|
| Big Horn County | | |
| 1966 | | 67.89 |
| 1970 | | 76.62 |
| 1974 | | 95.86 |
| 1975 | | 74.86 |
| Rosebud County | | |
| 1966 | | 75.65 |
| 1970 | | 95.29 |
| 1974 | | 93.20 |
| 1975 | | 82.18 |

As shown above, countywide mill levies for Big Horn and Rosebud Counties were lower in 1975 than in 1974. Also note the downward trend in countywide mill levies for both counties since 1970, a period during which coal production increased significantly in these areas. Such countywide levies do not include mill levies by individual school districts; however, it is important to note that mill-levy rates for the Squirrel Creek School near Decker have decreased approximately 30 mills in the last 4-5 years (Jim Hamilton, Decker area resident, oral testimony at public hearing on proposed Decker mines, November 17, 1976).

The development of a population projection is an attempt to foretell the future. To do so with any reasonable assurance of accuracy, it is necessary to specify, as well as possible, the variables or events which may influence the future. Unless these variables can

the adequacy of the statement: "No other coal or industrial development will occur within the impact area boundaries especially in the vicinity of

6 Sheridan". This assumption at once recognized the need to examine cumulative effects of development and then arbitrarily refuses to do so. It says that no other applications to mine were actually on line. The writer recognizes the existence of large amounts of coal and interest in it -- How in the world could such an erroneous assumption be made?

7 There is already a new mine begun in Sheridan County - the Public Service Company of Oklahoma's Mine #1. Peter Kiewit and Sons (half owner of Decker) has another mine in the works along Tongue River in Sheridan County. The Whitney Mine. Pacific Power and Light has discussed plans for a power plant in the county to burn coal from a new strip mine proposed for Spring Creek in Montana. Shell Oil has also submitted information to the USGS concerning their strip mining intentions for Young's Creek and Little Young's Creek on the Crow Reservation. The Draft Impact Statement's refusal to look beyond merely Decker's proposed complex may mean that Sheridan residents will get caught in the near future with grossly inadequate services and no way to raise money other than through increasing taxes of local residents.

MINING PLANS

8 The assessment of the mining plan again reveals the limited nature of the Draft Impact Statement when it comes to cumulative assessments. While it may be beyond the scope of this statement to talk about all the existing and proposed developments on the Tongue River, this task must be done to prevent against piece-meal expansion. Unless the regional impact statement currently underway

be specified with some degree of certainty, careful scientific analysis demands that they be disregarded. In the case of the Sheridan area, there were no firm commitments to open additional mines or initiate other industrial developments at the time the demographic study for the two Decker proposals was made. Accordingly, the use of the questioned developmental assumption was both proper and correct.

6 Given the time constraints placed upon the task force, it was not possible to update in the FES the demographic and socioeconomic studies for the socioeconomic impact area that were made during the summer of 1975.

7 See figure 23 (p. 89) and table 1 (p. 87) for the location and a brief summary of existing surface coal mines in the northwestern part of the Powder River Basin, Montana and Wyoming. Consideration of tentative developments for which no specific proposals are available would be premature and subject to possible misinterpretation.

8 See text revision on p. 439. Cumulative impacts of existing and proposed mines in the area appraised in this environmental statement should be adequately addressed in the Northern Powder River Basin regional EIS, which is currently under preparation. It should be noted, however, that those measures that would mitigate impacts to the social and economic environment of Sheridan as a result of the Decker Coal Co. proposals (p. 490-511) would also help mitigate impacts on Sheridan from additional new mines in the area.

on the Northern Powder River Basin addresses in detail the question of cumulative impacts, this task will have to fall on site specific statements, such as this one.

The impact statement makes a couple very telling statements on the status of reclamation in Montana. The most striking one shows that the ultimate success of reclamation efforts at Decker is anyone's guess: "The time elapsed since reclamation efforts began at the West Decker mine site is insufficient to permit conclusive statements regarding the reclamation of the area. Time and additional reclamation research will prove or disprove whether reclamation, consistent with the Montana Strip and Underground Reclamation Act, is ultimately achievable at both the West Decker and the proposed new mine areas." (Pg. 538) Thus approval of these two new mines is an act of faith.

Furthermore, the impact statement makes no claim that revegetation will occur in the near future, if it occurs at all: "These natural processes are extremely subtle and involve many variables, therefore no time frame has been postulated for the complete process of secondary succession to climax vegetation, if indeed attainment of former climax is possible on these sites." (Pg. 572)

The draft statement goes so far as to say that the loss of certain vegetation may persist for hundreds of years, for example, silver sage reestablishing itself after the alluvium of creek channels in the mining area is destroyed.

The task of wading through the lengthy impact statement was made even more difficult since Decker greatly revised their strip mining plans long after

A basic assumption of the Montana Strip and Underground Mine Reclamation Act is that an extended period of time is needed to evaluate reclamation success. The Act requires that a revegetation bond, which is filed by the applicant, be held for a minimum of five years before release. It was not the intent of the Act to require MDSL to "guarantee" success by approving a reclamation plan. If such success could be "guaranteed" at the time of permit approval, there would be no need to maintain a revegetation bond for any extended period.

Applicants for a surface mining permit are required by the Montana Strip and Underground Mine Reclamation Act to submit to the Montana Department of State Lands detailed information on the natural and man-made characteristics of a proposed mining area (see p. 520-521). The Act charges the Department with evaluating such information and then, based on that evaluation and other knowledge available to the Department, either granting or denying a permit to the applicant. If a permit is granted, the Department in effect is saying that, to the best of its knowledge and ability, the applicant has complied with the Act and the applicant's reclamation plan is acceptable. The submittal and review of several mining plans as described in the FES illustrates the administrative review process inherent in the Act.

This sentence refers to the fact that climax vegetation would probably not be reestablished on mined areas for many years after mining. Revegetation, however, should occur the first growing season after reseeding.

See text revision on p. 2-3, 20-22 and 53-54 for an explanation of the relationship between the initial and alternate mining plans proposed for the East Decker and North Extension areas. See also response to comment 2B in letter 1.

they first submitted their proposal. There is a lengthy assessment of mining plans for both Decker East and North that may be discarded in favor of the alternative mining plans found in the last few sections. Thus, the treatment of these alternatives, one of which may be adopted, is a lot more vague than the critique of the mining plan as first proposed. This set up is extremely confusing since the problems with the first mining plan may be taken care of by one of the alternatives proposed hundreds of pages later. Reading and critiquing the statement is difficult since you almost have to read the volume backwards. However, we are pleased that Decker came up with new mining plans, even though late in the game.

11

Some of the revisions to the Decker East mining plan may be due to actions by the Northern Plains Resource Council. Last winter we became aware that Decker Coal Co. was interested in beginning their strip mining operations before getting a strip mining permit. Decker proposed to begin their first box cut along the reservoir and use the overburden as fill material for the railroad spur running along the east side of the reservoir. They claimed that although they would be removing overburden over coal in the proposed strip mining area prior to getting a permit to strip mine, they called the action construction of preliminary facilities, such as a railroad spur, since the overburden would be used as fill for the spur.

12

12 Your comments have been noted.

After our meetings before various state officials, Decker revised their plan a number of times and then finally dropped the proposal altogether. Instead they developed alternative plans which did not require a box cut along the reservoir. Thus, while staying within the confines of the law, Decker also came up with alternative mining plans which appear superior to the first one

13

13 Your comments have been noted. See the description and analysis of Alternate Plan B for the East Decker area (p. 696-771).

13 offered for the Decker East Area.

All three alternative plan B's avoid the serious disruptions to Deer Creek contained in the original proposal. We agree with the Department of State Lands to keep strip mined spoils outside the Deer Creek channel, and to avoid massive fill for the railroad loop at the mouth of Deer Creek. In addition, all three alternative B's would allow more coal to be removed than originally proposed. B-3 would total 56 million tons more. (Pg 656)

14 After reading backwards and forwards, it is hard to know exactly what the impacts of the alternative mining plans would be. However, if one of them is adopted, the mitigating features which still relate to these plans should also be used.

14 Your comments have been noted.

15 In conclusion, the Draft Impact Statement is a huge document concerning proposals for a huge strip mining complex on Tongue River Reservoir. If approved, the two new strip mines will take 6,040 acres out of production for at least 20 years. With the success of reclamation uncertain, it may be a lot longer than 20 years. We hope the state and federal officials look at this proposal in great detail and impose the necessary requirements and restrictions.

15 Your comments have been noted. See p. 650.

LETTER 23

NORTHERN PLAINS RESOURCE COUNCIL

421 STAPLETON BUILDING
BILLINGS, MONTANA 59101

Mr. Leo Berry
Acting Commissioner
Department of State Lands
Capitol Station
Helena, MT 59601

November 29, 1976

Dear Mr. Berry:

The following comments from the Northern Plains Resource Council concern the Department of Interior and the Department of State Land's Draft Environmental Impact Statement on the proposed East Decker and North Extension Coal Mines in Big Horn County, Montana.

As you are aware, with these two applications for new strip mines, the Decker Coal Company proposes to open the largest coal strip mining complex in the United States, reaching approximately 20 million tons/year by 1979 and continuing at that rate for 20 years. Decker East and North would take 6,040 acres out of production for at least that amount of time, and perhaps a lot longer depending on how well reclamation efforts fare.

Because of the magnitude of this proposal, we urge the Department to give careful attention to writing a final impact statement, expanding the assessment to cover the inadequacies of the draft. Complete restoration of the area must be a certainty before strip mining commences, particularly since this proposal means surrounding the southern portion of the Tongue River Agricultural Reservoir with strip mines.

COAL CONSERVATION ACT

Despite the huge amount of coal that Decker proposes to strip mine with these two new pits, the company is currently leaving significant amounts of coal in the ground at their existing Decker West mine. At Decker West, the company strip mines only the upper two seams, while at both Decker North and East, they propose to mine all three.

It seems strange that the company plans to recover the Dietz 2 coal seam both north and east of their existing strip mine, yet claims it is uneconomical to recover at Decker West. To keep destruction of land by strip mining to a minimum and to comply with the Montana Coal Conservation Act, maximum recovery of coal is essential. The final EIS must investigate more fully why it is "uneconomical" to recover the Dietz 2 seam at Decker West (p. 82, DES) while it is feasible at the two new proposed strip mines.

See response 9 to letter 22. The text has been substantially revised, especially the discussions of archaeological and historical sites, Alternate Mining Plan B (Plan B-3 in the DES), and mitigating measures for impacts to land use, community development, social structure, and social services.

The Decker Coal Co. did not submit plans to mine the Dietz 2 coal seam at the West Decker mine because of (1) mine configuration limitations; (2) cost of mining; and (3) contract commitments with coal purchasers. It should be noted, however, that the Montana Department of State Lands and the Area Mining Supervisor, USGS, will continue to appraise all available data for the West Decker mine and will take whatever steps are necessary to assure compliance with State and Federal coal conservation statutes and regulations. Recently the Montana Department of State Lands requested that the Decker Coal Co. submit copies of their coal sale contracts for coal removed from the West Decker mine. To date, no submittals have been made.

RECLAMATION

Although the draft EIS has already been a long time in coming, the length of time in preparation does not automatically make it complete. As a matter of fact, in numerous areas it is inadequate, particularly in the treatment of reclamation.

The results of reclamation efforts in Montana to date do not indicate that reclamation will definitely succeed. Likewise, they do not show that reclamation is impossible. However, on the basis of past experience in the state, and at Decker in particular, there is no guarantee that reclamation will work within the near future.

The draft EIS refers to that situation:

"The time elapsed since reclamation efforts began at the West Decker mine site is insufficient to permit conclusive statements regarding the reclamation of the area. Time and additional reclamation research will prove or disprove whether reclamation, consistent with the Montana Strip and Underground Mine Reclamation Act, is ultimately achievable at both the West Decker and the proposed new mine areas." (p. 538)

However, rather than pursuing the problem further, the draft EIS leaves you hanging by a thread of hope that reclamation will somehow occur sometime:

"These natural processes are extremely subtle and involve many variables, therefore no time frame has been postulated for the complete process of secondary succession to climax vegetation, if indeed attainment of former climax is possible on these sites." (p. 572)

The draft goes so far as to say that complete reclamation in certain areas may take 100 years since destroying the alluvium makes re-establishing silver sage an extremely lengthy process. If so, we trust that the state and federal government are prepared to hold bond on these areas for that length of time.

In offering no specific time frame for re-establishing native grasses after strip mining, the draft EIS fails to assess completely the impacts of strip mining on the area. Even with the benefit of time, plant succession, development of soil nutrients and species diversity may still not succeed. Furthermore, even if reclamation does succeed at some later date, the time frame is crucial to the decision to approve or deny strip mining. Destroying ranching or farming in an area for twenty years is one equation. Destroying it for 100 years or for 1000 years is quite another one.

In the absence of any discussion of time, we are left to our own imaginations to conjure up pictures of the West as either lush rolling hills supporting five AUM's per acre one year after strip mining or conversely as a desert landscape requiring hundreds of years to achieve former productivity. It is the task of the final EIS to paint a definite and complete picture so a sound decision on the permit applications can be made.

3 See responses 9 and 10 to letter 22.

This comment refers to the following statement on p. 365 of the FES.
"Vegetation diversity, a pattern which reflects differential soil, exposure, and grazing conditions may be lost for many years after mining ***. The competitive advantage of some deep rooting plants within the East Decker area may be lost for many years after mining, thus also affecting plant diversity."

Reclamation as required by both the Montana Strip and Underground Reclamation Act and 30 C.F.R. 211.40 does not require that every species growing in an area prior to mining be reestablished on the revegetated surface before release of reclamation bonds.

Montana statutes and regulations (Section 5-1045 R.C.M. 1947) require that reclamation bonds be held by MDSL for a period of at least five years after planting has occurred or until such time as that agency determines that a permanent, diverse, and primarily native plant cover has been established on the revegetated mined areas. Such a cover must be capable of:

(a) feeding and withstanding grazing pressure from a quantity and mixture of wildlife and livestock at least comparable to that which the land could have sustained prior to the operation;

(b) regenerating under the natural conditions prevailing at the site, including occasional drought, heavy snowfalls, and strong winds; and

(c) preventing soil erosion to the extent achieved prior to the operation.

Should MDSL determine that any revegetated surface at the Decker mines (existing and/or proposed) does not contain a suitably diverse vegetative cover capable of meeting the above criteria, the reclamation bond for such surfaces would not be released until such criteria are met.

Federal regulations (30 C.F.R. 211.40(13)(ii)) provide that bonds posted by the Decker Coal Co. must be held by the regulating agency a minimum of 5 years after the first planting with a total period of liability not to exceed 10 years from the original planting unless otherwise provided in the mining permit. Liability may be extended for a period of up to five years beyond the period initially established if the financial liability that would be incurred by the operator as a result is reasonably commensurate with the increased probability of successful revegetation.

5 Your comments have been noted. See response 4 above and responses 9 and 10 to letter 22.

CUMULATIVE IMPACTS

The draft EIS raises questions concerning the assessment of cumulative impacts that will only become more complicated as time goes on. The draft EIS chose to call Decker West part of the existing environment around the Tongue River Reservoir, thus deleting it from discussions of cumulative impacts from Decker East and North.

6 In doing so, the draft EIS has fundamentally ignored the nature of cumulative impacts. On the one hand, the draft assesses cumulative impacts of Decker East and North, only to leave out Decker West entirely. While land uses other than strip mining have effects on Tongue River, the impact statement process, as a minimum, must consider both existing and proposed stripmines in any discussion of cumulative impacts.

7 Considering only impacts of new mines as incremental additions to the existing environment that includes a strip mine is totally inadequate. Impacts on hydrology, community services, wildlife and other resources often total more than the algebraic sum of the individual new proposals. It is unbelievable that the draft EIS would consider each new mine, once approved, part of the baseline when dealing with complex inter-related systems interrupted or destroyed by strip mining. The final EIS should expand the assessment of cumulative impacts to include Decker West.

DECKER EAST ALTERNATIVES

8 The format of the Decker East sections of the draft EIS is extremely confusing. By the end of the entire tome, it is unclear exactly what Decker is proposing to do. If you use the sheer number of pages as a guide, you would assume Decker is still proposing the original plan since it received the most complete assessment. However, you get the sneaking suspicion that one of the alternatives is more viable than the original plan, particularly B-3. The draft does not do much to confirm or deny that suspicion. There are few clues as to the most likely alternative and its impacts.

9 The final EIS must go into the most likely alternative in much more detail than the draft offered. That alternative assessment should include a full discussion of the impacts and mitigating measures required, particularly as it concerns the creation of two lakes within the proposed strip mining area.

STRIP MINE SITING ACT

The Decker East application presents another tricky legal problem which the Department of State Lands has begun to pursue - the applicability of the Montana Strip Mine Siting Act to the Decker East application. Decker contends that they have been grandfathered out of that act by meeting the requirements for "proven specific notice" to the Department of State Lands contained in the exemption clause.

Decker's substantiation of that statement rests with a two page affidavit from Mr. John F. Ratchye, Jr. of Peter Kiewit Sons' Inc., which states that at some meeting prior to January 1, 1974, he gave Mr. Schwinden specific notice

Cumulative effects of the Decker proposals are discussed in section III.C. (see text revisions on p. 439). The West Decker mine is currently in operation and therefore is properly treated as part of the existing environment. Where relevant, the added effect of the West Decker mine, which is regarded as part of the local baseline conditions, is included in the discussion of cumulative effects (e.g., see section III.C.3.a.(5) and III.C.3.b.(3)). Cumulative impacts of existing and proposed mines in the area should be adequately addressed in the Northern Powder River Basin regional EIS, which is currently under preparation. It should be noted that those measures that would mitigate impacts to the social and economic environment of Sheridan as a result of the Decker Coal Co. proposals (p. 490-511) would also help mitigate impacts on Sheridan from additional new mines in the area.

See text revisions on p. 2-3, 20-22, and 53-54 for an explanation of the relationship between the initial and alternate mining plans for East Decker area.

The appraisal of Alternative Mining Plan B-3 (Plan B in the FES) has expanded from 9 pages and 3 illustrations in the DES to 76 pages 8 illustrations in the FES. Impacts related to the proposed "final" lakes that would form in the final cuts left in the East Decker area are discussed on p. 741-743. Mitigations to these impacts are discussed on p. 760-764.

Your comments have been noted. The Montana Department of State Lands also contends that the Decker Coal Co. has been "grandfathered" out of the Montana Strip Mine Siting Act. An affidavit on record signed by former Commissioner Ted Schwinden verifies that he met with Mr. Jack Ratchye of the Decker Coal Co. prior to January 1, 1974. At this meeting, Mr. Schwinden states that he was given specific notice that contracts for preparatory work and for coal sales were in existence for the proposed East Decker mine. Therefore, the Department of State Lands believes that no further investigation into the matter is necessary.

of contracts for preparatory work and for coal sales from the proposed Decker East mine. The affidavit does not state when the meeting occurred, nor exactly what was said. The contracts were not attached to the affidavit nor is there a corresponding affidavit from the former Commissioner of State Lands to substantiate it.

- 9 We request that, as part of the final EIS, the Department finish the investigation into this matter. The legal implications of this question assume particular importance since Decker has begun preliminary construction of facilities in the area of the proposed Decker East mine prior to receiving a strip mining permit for that area.

DECKER NORTH STREAM DIVERSIONS

- 10 The most troubling aspects of the Decker North proposal which need further investigation are the proposed channel diversions and relocations of Spring Creek, South Fork Spring Creek and Pearson Creek. The draft points out that these proposals may create problems of flooding, increased erosion and sedimentation (p. 376 - 387). The final EIS must discuss measures to eliminate these problems.

- 11 After strip mining the draft identifies problems with these three creeks flowing over the final highwall, eroding a deep narrow trench or gully upstream from the highwall" (p. 392). The final must specify what protective measures the mining company could adopt to take care of this problem, particularly as it might "cause significant reduction in plant cover on the dissected valley floor," as well as causing large volumes of sediment to reach the Tongue River Reservoir. (p. 392)

DECKER NORTH & EAST SOILS

- 12 The draft also makes mention of sodic spoils problems at both Decker East and North if the spoils from below the upper-most coal bed are left within eight feet of the surface. The final must address this point, and specify that if a permit is granted, the condition be attached to it that these spoil materials not appear within eight feet of the surface. (p. 361)

DECKER NORTH AS A MINE EXTENSION

- 13 The draft EIS identifies Decker North as the north extension of the Decker West strip mine. As Decker North is an entirely new pit requiring its own mining equipment, it is clearly a new mine. The final should change this designation as well as set a precedent within the Department to call any non-contiguous pit a new mine and not a mine extension, regardless of its proximity to an existing strip mine.

- 10 Measures to mitigate these problems are discussed in section IV.B.b.(2)(b).

- 11 Measures to mitigate the highwall problem are discussed in section IV.B.b.(2)(b).

- 12 Burial of sodic spoils is discussed in section IV.B.2.a. Adopted Rules and Regulations pursuant to Title 50, Chapter 10, R.C.M. 1947, section 26-2.10(10)-S10310(1)(b) require the operator to bury all materials not conducive to revegetation techniques, establishment, and growth at least eight feet below the surface.

The MDSL is bound by the definition of "new mine" as set forth in the Montana Strip and Underground Mine Siting Act (Section 50-1603(4) R.C.M. 1947).

'New Strip mine' means a strip or underground mining operation proposed for an area of land which the Department determines, because of distance from an existing strip mine or underground mine operation or their respective facilities or because of important differences in topography, soils, wildlife, geologic structures, aquifers or vegetation from an existing strip mine or underground mine operation, does not constitute an expansion of an existing operation.

MDSL determined that, based on the above criteria, Decker Coal Co.'s North Extension mine does not constitute a "new mine," but is instead an extension of the existing West Decker operation. That act permits the construction of facilities; because no new facilities are contemplated for the North Extension mine, there is no reason to call it a "new mine" or to apply provisions of the Siting Act.

INDEPENDENT DATA COLLECTION

14 Unfortunately, the compilation of much of the data for the draft EIS rested with the coal company proposing to strip mine the area. Thus, in numerous cases, the EIS can offer no substantiation of the data, but merely try to interpret it. These problems could be avoided, and a more complete EIS compiled if the Department of State Lands with the federal government assessed a fee from the applicant based on a percentage of the total cost of the project to compile an environmental assessment.

15 In the long run, such an arrangement would make the Department of State Lands' job easier since they would be involved from the beginning in assessing the total impact of a permit application. It would also provide the Department with information which they knew was reliable, eliminating some of the current duplication of efforts.

Comments prepared by:

Sarah Ignatius
Research Coordinator

cc: Director, USGS, Reston ✓
Brace Hayden

The EIS preparation task force utilized Decker Coal Co. data in their analyses of soils, overburden, coal, vegetation, and air quality. All other data utilized in the FES were collected by task force members or were obtained from other sources cited in the text. Data furnished by the Decker Coal Co. were not accepted without question. All data used in compiling this environmental statement were appraised in relation to established norms for this general area or to similar data obtained from other areas having comparable features or characteristics.

The 1975 Montana Legislature passed an amendment to the Montana Environmental Policy Act (MEPA) permitting State agencies to collect under certain conditions fees from applicants for the purpose of collecting and compiling data for use in preparing environmental impact statements. Administrative rules and regulations to the MEPA "Fee Bill" were adopted by MDSL in April 1976.

The Decker Coal Co. proposals for the East Decker and North Extension mines were submitted to MDSL prior to the effective date of the MEPA "Fee Bill" and, hence, the Department could not assess the Company a fee to be used in the preparation of this environmental statement.

The Company, however, voluntarily contributed adequate monies to the Department to be used in the preparation of this statement. Accordingly, it is doubtful that the absence of a MEPA "Fee Bill" at the outset of this endeavor had any significant effect on the quality of the Final Environmental Statement.

The MEPA "Fee Bill" is now fully implemented by MDSL and should greatly facilitate the preparation of environmental statements in the future.



Powder River Basin Resource Council

Sheridan, Wyo. 82801
150 W. Brundage
(307) 672-5809

COMMENTS OF THE POWDER RIVER BASIN RESOURCE COUNCIL ON THE DRAFT ENVIRONMENTAL
IMPACT STATEMENT ON THE PROPOSED PLAN OF MINING AND RECLAMATION,

EAST DECKER AND NORTH EXTENSION MINES, DECKER COAL COMPANY

BIG HORN COUNTY, MONTANA

UNITED STATES GEOLOGICAL SURVEY MONTANA DEPARTMENT OF STATE LANDS

Presented on behalf of the Council by Tom France, Staff, at public hearing in
Sheridan, Wyoming, November 18, 1976.

The Powder River Council appreciates the opportunity to comment upon the
proposed Decker Mine expansion and the Draft Environmental Statement prepared by
the U.S. Geological Survey and the Montana Dept. of State Lands.

Because this mine will be located entirely within Montana, we have
limited our comments to those aspects of the mining operation that will affect
Sheridan County and the State of Wyoming.

It has been our experience that the place to start when examining
environmental statements is to review the purpose and requirements of the
National Environmental Policy Act of 1969, which outlines the reasons for
performing environmental and related assessments prior to authorizing projects
which will cause significant impacts upon surrounding communities and areas.

By reviewing impact statements in the context of the law, we can more
clearly perceive whether each EIS is adequate to fulfill the purpose and
requirements of NEPA.

In this case, we can see that the Decker EIS is not adequate.

NEPA states, as I quote:

"The purposes of this Act are: To declare a national policy which will
encourage productive, enjoyable harmony between man and his environment;
To promote efforts which will prevent or eliminate damage to the environment
and stimulate the health and welfare of man."

The preparation of Environmental Impact Statements is supposed to be
a means by which the public can evaluate adverse and beneficial effects upon
the natural environment, man's created environment, and man himself, and
then seek ways to avoid or at least reduce unnecessary adverse impacts.

1 Your comment has been noted.

This type of forward-looking review is the key to making informed, sensible decisions about future development of our valuable natural and human resources.

Unfortunately, however, we have found in the Decker EIS only the first step in the process--identification of the problems. The problems of concern to the Powder River Council fall under the heading of social impact.

The Decker expansion will cause severe social impacts in Sheridan County. No one denies this; the statement as much as states this conclusion outright.

Housing will be in extreme short supply, obligative public services will lag behind the rate of population growth, schools will be crowded, the school districts will face higher indebtedness, medical services will be overextended--these problems will be great, and the social consequences from these problems will be greater yet. The EIS does contain descriptions of these problems.

But the EIS does NOT contain the most crucial component--description of solutions to these serious problems. The question stands out in neon--How will Sheridan deal with population influx and solve these socio-economic problems? Worse yet, how will Sheridan pay for these solutions?

Another question also stands out--why did not the EIS contain suggested methods to alleviate these problems? Why did the EIS writers stop at cataloguing, at graphic description, at recitation of a formula for decline of quality of life in a beautiful Western community? We think an explanation is required.

The Environmental Statement is an encyclopedia of impact--of both natural and human variety. One needs only to refer to the proper headings, as in any other encyclopedia, to see that. We found that:

- 2 + nearly 2000 people will move into the Sheridan area in the space of three years; (Vol I page 442)
- + much of Sheridan and peripheral areas will change from open land to intensive urban usage; (Vol I p. 446)
- + community appearance and orderly development could be greatly reduced by the Decker-related influx; (Vol I p.447)
- + local governments in Sheridan County are projected to suffer financial deficits because of the Decker expansion; (Vol I p. 454)
- + the Sheridan school districts will be required to undertake a substantial building program, a difficult proposition because the Sheridan school district currently has a bonded indebtedness of almost 92 per cent of its legal bonding capacity; (Vol I p. 454)

Sections IV.C.3. and IV.C.5. have been substantially revised in the FES to include an expanded discussion of possible measures to mitigate economic impacts and impacts upon social structure and social services, primarily in the Sheridan area. More detailed suggestions for solutions to identified problems, and especially suggestions that entail increased tax revenues, must come from long-term, cooperative, and intensive studies by tax experts, planners, and political officials. This environmental statement is not a substitute for that planning process; it is only one of several tools available to state and local governments in reaching solutions to the stresses that would be placed on existing social and economic structures. As stated on p. 590-611, the city of Sheridan and other Sheridan area communities have begun to build a framework for problem solving through the efforts of the Sheridan Area Planning Agency.

+ housing is currently a severe problem in Sheridan and the influx of approx. 2000 people from the expansion will further aggravate this situation; (Vol I p. 460)

+ sewage treatment facilities may have to be expanded; (Vol I p.464)

+ school rooms will be crowded; (Vol I. p. 464)

+ public services, including police protection and social services, will have to be expanded; (Vol I. p. 464)

2 + Wyoming will receive no severance taxes or Federal mineral royalties from the Decker Mine;

+ increased rail transport of coal will cause safety problems at rail crossings, especially in Wyarno.

These problems are not minor--they will affect the lives and the pocket-books of Sheridan residents for years to come. Yet the impact statement provides us with no direction about how these problems will be solved. The statement points out that land use planning could provide some assistance, but there is not mention of the status of land-use planning in Sheridan County.

4 The statement admits that coal tax revenues will provide millions of dollars for Montana, and that Wyoming will experience only deficits, but it offers no suggestions for ameliorating this unacceptable situation.

5 The Decker EIS has identified problems while making no suggestions for solution of these problems. This approach ignores the fundamental purpose of the National Environmental Policy Act.

We recognize that the Federal government is limited, and rightfully so, in its ability to provide answers to local and state problems, but there can be no doubt that approval of the Decker expansions will be a major federal action triggering a series of severe social impacts for Sheridan County. Such approval by the Department of Interior confers responsibility for these impacts upon the Department. This responsibility must be taken seriously, but has not been so addressed in the Draft EIS.

6 It appears to the Powder River Council that several options are open to the Department by which social impacts can be avoided or reduced in scope. Among these options are denial of the permits to expand the Decker operations, delay of approval, or the attachment of conditions upon such approval so that social impacts will be minimized. Serious attention must be paid to these possibilities by Interior if quality growth is to be achieved in Wyoming.

7 The Powder River Council is raising serious questions about serious problems, and we are looking for constructive approaches for a solution. We are not advocating

3 See text revisions on p. 260-269, 472 and 590-593 for a description of the status of land-use planning in the city of Sheridan and in Sheridan County.

4 See text revisions on p. 593-596. See also the response to comment 3 in letter 27.

5 See chapter IV. entitled "Mitigating or compensating measures" (p. 509-619).

6 The EIS is one of the documents that provide a basis for decisions by the Office of the Secretary of the Interior. The options, including those proposed by your comment, are addressed in the FES under the administrative alternatives available to the Secretary of the Interior (see section VIII.B.). These include no action, defer action, prevent further development in existing leases, restrict development in existing leasing, approve mining plan after modification, etc. These measures and their potential impacts are provided to the Secretary for his use as conditions of approval or modification of the mining plan.

7 Your comments have been noted.

denial of the Decker expansion; we are advocating a realistic approach by the responsible agencies to prevent unreasonable and unacceptable impacts upon Sheridan County, the City of Sheridan, and the taxpayers of Wyoming.

We feel that the Decker EIS is inadequate because it provides no answers, no solutions, no alternative. A further inadequacy, and a very substantial one, is that the EIS gives no consideration to the multiplier effects of other planned development in the Sheridan area upon the problems that the Decker expansion will cause. The Decker EIS, by ignoring other concurrent development, has understated the magnitude of the problems that Sheridan will face by a significant fact. The regional implications of the Decker development occurring near other large coal mines and other projects are enormous--these implications are not addressed in the Decker EIS. This omission is a fatal flaw. A partial assessment of the problems that will occur is no better than no assessment at all. Of what value is a partial EIS to a community struggling to deal with overwhelming problems that are unprecedented in our experience? What guidance, what leadership, has Interior provided us? The Decker EIS represents a substantial investment of time and money, yet we are thrown back upon our own resources because it is flawed beyond usefulness. Again, we say that the Decker EIS is incomplete and inadequate in light of NEPA's requirements, because it provides us no handles, no tools, no help, for the problems that approval of the Decker expansion will bring.

Sheridan is facing a series of major developments, all of which will add substantially to the social problems enumerated in the Decker encyclopedia. The Whitney, the Public Service of Oklahoma, the Shell and the PP&L Spring Creek Mines will add greatly to the rate of population growth in Sheridan County. Two of these mines, like Decker, will be in Montana and will produce no severance tax revenues for Wyoming tax rolls. These deficits will have to be made up for, at least in part, by Wyoming taxpayers.

Pacific Power & Light is also considering the siting of a large coal-fired power plant near Tongue River in Sheridan County.

All of this development is planned to begin within the next three years, concurrently with the Decker expansion. The cumulative effects of all or part of this growth coming in less than a decade are enough to totally remake the community of Sheridan. What tools does Sheridan possess to cope with, to finance solutions to, these problems?

Because of the impact which the Decker Mine will cause, and because of the failure of the EIS to adequately assess these impacts, the Powder River Council respectfully suggests that the Department should condition the permit as follows:

- 1) The permit should be granted upon completion of the final EIS, but no

8 Your comments have been noted. See text revision on p. 439; also, see the above response to comment 2 and the response to comment 8 of letter 22.

9 See above response to comment 2.

10 See above response to comment 6.

10 construction can be allowed at the proposed Decker expansions until the comprehensive plan for Sheridan County has been finalized and adopted by the Board of County Commissioners of Sheridan County, and rules and regulations have been adopted that fully implement that final plan;

2) In the interim period, while the County is preparing and implementing the comprehensive plan, a committee should be established by the Dept. of Interior, with consultation with the Governors of Wyoming and Montana, to study the problem of Montana receiving all of the severance taxes and mineral royalties from the mining operations while Wyoming will be forced to pay for social services without benefit of such revenues. The committee would be instructed to actively seek a solution to this discrepancy, including drafting of legislation or sponsoring of agreements between the states and the government. The committee should include representatives of state, local and federal government, local planners, and other persons who could contribute to the usefulness of the committee's work.

11 Your comments have been noted.

3) Construction would not be allowed at the proposed mine and/or appurtenant rail facilities until plans were devised and accepted to build a separated grade railroad/highway crossing on State Highway #336 near Wynano, Wyoming. Additionally, a survey should be conducted of all crossings to be affected by increased rail traffic from the expanded operations, and all safety hazards should be eliminated before any expansion of coal train traffic can occur.

Thank you very much for your attention to these remarks. We look forward to seeing these issues addressed within the Final Environmental Impact Statement. Again, thank you.

Your comments have been noted. See letter from Wyoming Department of Highways to Montana Department of Highways (p. K-11 and K-12, Appendix K) and correspondence from Burlington Northern Inc. to the Powder River Basin Resource Council attached to letter no. 25.



Powder River Basin Resource Council

Sheridan, Wyo.
82801
150 W. Brundage
(307)672-5809

November 23, 1976

Director
U.S. Geological Survey
National Center
Mail Stop 108
Reston, VA 22092

Dear Sir,

On Nov. 18, I testified on behalf of the Powder River Council in regards to the Draft Environmental Impact Statement issued on the Decker Strip Mine expansion in southeastern Montana. At the suggestion of Norm King, Team Leader for the Impact Statement, I would like to offer the following clarification to my remarks.

The Powder River Council recommended that the Secretary of Interior approve the Decker expansion, but that he do so with conditions attached to the permit. One of our suggested condition was that no construction be allowed to commence at th mine sites until the comprehensive land use plan for Sheridan County has been adopted by the Board of County Commissioners. Our reasons for this suggestion lay in the substantial impact that will be visited upon Sheridan County by the mine expansion, and the Impact Statement's identification of the lack of preparation on the part of Sheridan for this impact.

I would like to state at this time, as I failed to do at the hearing, that the Powder River Basin Resource Council is in no way seeking an open-ended delay to the Decker Mine. The Sheridan County comprehensive plan will be issued in January of 1977, with approval by the County Commissioners hoped for by July. Implementation of the rules and regulations will follow during the fall. We understand that the earliest the Secretary can approve the Decker expansion is April, so we are talking about a three to six month delay in the construction of the Decker east and north mine sites. We feel this is a reasonable amount of time to ask for considering that the life of the mine will be over 20 years.

I would also like to supplement my remarks on the railroad problem that exists east of the City of Sheridan. The Powder River Council, residents of the WYarno community and the Board of County Commissioners all testified as to the need for a separated grade on Highway 336 between Sheridan and WYarno. It was the feeling of all who testified at the hearing that the increase in unit train traffic that will come from the Decker expansion mandates this safety precaution. The Powder River Council and members of the WYarno community have been trying to work with the Burlington Northern to reach a solution to this problem. To further your understanding of this problem, I would like the enclosed letters to be inserted into the record of the Decker hearings. The first letter is a simple request by ourselves and people from WYarno to sit down with the railroad and the appropriate government officials to see if a solution could not be attained. The second letter is the response of the Burlington Northern to this request. As you can see, the

1 Your comments have been noted.

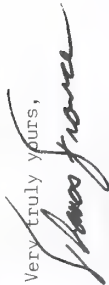
2 See text revisions on p. 619-621. See also responses to comments in letters 18 and 29. The attached correspondence from Burlington Northern Inc. was utilized in the preparation of the FES.

Director, U.S.G.S
11/23/76
page 2

2 Burlington Northern has been less than responsive in solving this problem.

Please be advised that our comments were submitted into the record at the hearing in Sheridan on November 18, and that a more detailed explanation of our feelings was contained in them.

Very truly yours,

A handwritten signature in cursive script, appearing to read "Thomas France".

Thomas France
Staff Coordinator



Powder River Basin Resource Council

Box 6221
Sheridan, Wyo. 82801

150 W. Brundage
(307) 672-5809

October 28, 1976

Robert J. Davis
Assistant Superintendent
Burlington Northern
841 Broadway
Sheridan, Wyo. 82801

Dear Mr. Davis,

We very much appreciate your attendance at the meeting with the Interstate Commerce Commission, and hope that your presence reflects a renewed commitment by the Burlington Northern to help solve railroad problems in northern Sheridan County.

We see a number of avenues open to Burlington Northern and county residents, at least on many of the issues discussed with Messrs. Chais and Fancher, and it seems to us that now is the time to start working on these problems so that things will be ready for implementation next summer. To reiterate the points raised at the meeting, we would like to see:

- 1) Burlington Northern develop a time schedule and specifications for fencing, possibly in accordance with the highway standards that were used on portions of the Decker spur. Most of the fences in our area need to be rebuilt completely, and we recognize that this probably cannot be accomplished in a single season. Therefore, we would like the railroad to outline a program showing where fences will be upgraded over several years, and then make this plan available to landowners.
 - 2) Burlington Northern establish a time-frame for spraying operations, concentrating such efforts in the late spring when they will do the most good. We would also like B.N. to state what kinds of equipment will be used, so that an adequate job can be accomplished.
 - 3) The railroad establish a date when signal devices (bells and flashing lights) will be placed on all county crossings. In our area we are particularly concerned with the crossing just east of Wynno, but we know of dangerous crossings throughout the County. We also feel that these signal lights should be considered a temporary safety measure, and that the railroad should be planning to separate grades on all public roads within the next few years. The projected increases in unit train shipments of coal mandate this step.
 - 4) Burlington Northern set up a meeting with local residents and appropriate County and State officials to discuss the situation at the "Y" crossing on state highway 336. We feel immediate steps need to be taken to separate this grade.
- We feel that local, state and federal officials should be involved with all of these problems, but we would like to make every effort to solve these problems locally, if possible. Many of these issues and problems are a result of poor commun-

at Davis
e.2

ication between landowners, management and track crews. Hopefully, we have now
opened a dialogue that will lead to successful resolution of all of these problems.

Very truly yours,

Chester Hape

Leonard Brownell

Vera Grady

Gerry Costel

Ed Symons

Sheridan Burgess

Lucie Bourdon

cc: Tom Nicholas
William Laya
John Davies
V. Frank Mendicino
Richard Chais
Stanley Fancher



BURLINGTON NORTHERN

841 Broadway
Sheridan, Wyoming 82801
Telephone (307) 374-1741

OFFICE OF
ASSISTANT SUPERINTENDENT

November 15, 1976

Powder River Basin Resource Council
Box 6221
Sheridan, Wyoming 82801

Sheridan, Wyo.

Please refer to your letter of October 28, 1976, in connection with a number of items raised at a meeting held with the Interstate Commerce Commission at Sheridan, Wyoming.

Following reply is offered to the points raised in your letter in the sequence of your letter:

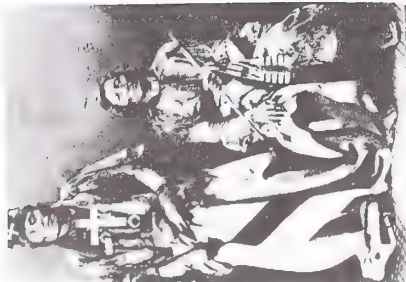
1. Burlington Northern Inc. does not have a wholesale program to renew fencing but when existing fencing requires replacement or patching, Burlington Northern will comply with its statutory obligations under Wyoming law.
2. Burlington Northern will cooperate with county officials in programming its spraying program. Normally we will use Tordon 212 or 22K chemical, which is purchased from the weed control group. It will be applied by Fargo sprayer or hand spraying methods.
3. The BN cannot establish a date when signal devices will be placed on all county crossings. The motoring public is the principal beneficiary of projects which improve crossing safety and financial support of such projects should so reflect. Federal and state funds are available to the signal device installations and BN will support these projects where such installations can be justified by federal or state bodies. For any particular crossing it is suggested that you contact your State Highway Department to see if federal funding is available. State funds are available through your Wyoming Public Service Commission under General Order 31.

4. We feel the questions regarding the grade separation at the "wave" crossing should be directed at Wyoming State Highway Officials. We see no need for Burlington Northern to set up a meeting. If state highway representatives set such a meeting, we will arrange for representation.

It is hoped that the above will guide your group in a proper direction for relieving solutions to some of your problems.

Very truly yours,

R. J. Davis
Assistant Superintendent



LETTER 26

NORTHERN CHEYENNE TRIBE INCORPORATED

P.O. BOX 128

LAME DEER, MONTANA 59043

LITTLE WOLF AND MORNING STAR - Out of defeat and exile they led us back to Montana and won our Cheyenne homeland that we will keep forever



WOHEHIV - The Morning Star

November 24, 1976

Director

U.S. Geological Survey, National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir:

The Northern Cheyenne Tribe feels the East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana, Draft Environmental Impact Statement inadequately addresses the possible water quality impacts that could result from the expansion of mining around the Tongue River Reservoir.

The Northern Cheyenne Tribe has a major investment in the water of the Tongue River. The tribe is currently paying storage space in the reservoir and has begun a large tribally operated sprinkler irrigation project down stream. The Northern Cheyenne Tribal Council has passed a resolution which provides for maintaining the good water quality of the Tongue River. It has also gone to the courts to establish its sovereign rights to use Tongue River water both now and in the future.

In reviewing the Draft Impact Statement, four major factors affecting the impact to the water quality of Tongue River and the Tongue River Reservoir have not been evaluated or considered:

OFFICERS

Allen Rowland
President

Wendell Shoulderblade
Vice President

Jacqueline Bement
Treasurer

Erma Spang
Secretary

TRIBAL COUNCIL

Joe Bear
Ashland

Shirley Parker
Ashland

Llevando Fisher
Birney

Ted Risingsun
Busby

Rudolph King, Sr.
Busby

Leroy Pine, Sr.
Busby

Kenneth Beartusk
Lame Deer

Daniel Foote
Lame Deer

Dennis Limberhand
Lame Deer

Doreen Pond
Lame Deer

John Woodenlegs
Lame Deer


Fred Whitewolf, Sr.
Lame Deer

Raymond Spang
Lame Deer

Floyd Waters
Muddy

1. The contention of this E.I.S that there will be no measure-able impact to the water quality of the Tongue River Reservoir and River has not been explained to the Tribe's satisfaction. The Tribe believes that water degradation associated with mineral-ized ground water discharging to the Reservoir from spoil piles adjacent to the mining areas will be measurable. The report also does not clearly indicate how this mineralized water will be assimilated and where water would be sampled to detect the presence or absence of water quality degradation.
2. The spoil flushing effect of stage variation of a large Tongue River Reservoir was discussed, however, the probability of a similar effect resulting from the present stage fluctuations of the reservoir was not addressed. It is probable that drainage of highly mineralized spoil water will measurable effect the water quality of the reservoir and river at low reservoir stage.
3. The real potential that large scale withdrawals of water above the reservoir will reduce the reservoir inflow and in turn significantly reduce the flushing and dilution function of the reservoir has not been assessed. It is believed that during the life of the proposed project and after its completion upstream energy and agricultural use of the stream will consume large quantities of water which will then not be available for dilution of discharging mineralized spoil water.
4. If degradation of reservoir and river water does occur the methods of correcting the degradation and compensating water users has not been assessed.

The Northern Cheyenne Tribe feels that the Draft Environmental State-ment must further consider the impact of highly mineralized ground water discharge, the inevitability of reduced Tongue River inflow, the effect of a fluctuating reservoir stage, and plans to abate and compensate for degradation of the water quality of the Tongue River before a true environment impact can be assessed for the proposed mines.

Sincerely,

 Allen Rowland, President
 Northern Cheyenne Tribal
 Council
 For -

cc: Leo Barry Jr.
 Montana State Lands

- 1 Your comment has been noted. Mass balance calculations indicate that simultaneous release of mine effluent from the existing and proposed mines would be so small as to have virtually no detrimental effect on the use of the reservoir or its water (see table 44 and fig. 65). The same conclusion was reached by Van Voast and Hedges (1975) in their appraisal of the effect of mining on the quality of water in the Tongue River Reservoir. Water quality monitoring stations on the Tongue River downstream from the Decker area are described in an open-file report by the U.S. Geological Survey entitled, "Water-resources investigations of the U.S. Geological Survey on the Northern Great Plains Coal Region of Eastern Montana, 1975-76."
- 2 The Decker Coal Co. proposes to construct ground-water barriers in both the East Decker and North Extension areas (see sec. IV.B. 3.a.(1) (c)) to minimize inflow from the Tongue River Reservoir to the adjacent mine cuts. These barriers, if not removed after mining is completed, would greatly retard any postmining cyclical circulation between the reservoir and the spoils aquifer in response to water-level fluctuations in the reservoir. The effect would be to virtually eliminate any spoil-flushing effect as a result of stage variation in the existing reservoir. Breaching these barriers after mining is completed would partially restore cyclical circulation; however, movement of water into the spoils during high reservoir stage and back to the reservoir during low stage very probably would not exceed a few hundred acre-feet annually. The effect of that small amount of flushing on the quality of water in the reservoir would be inconsequential.
- 3 The Yellowstone River Compact apportions the waters of the Tongue River between the states of Montana and Wyoming. The terms of that compact prevent excessive withdrawal of water from the river up-stream from the Tongue River Reservoir and, according to Rick Bondy (Montana Department of Natural Resources and Conservation, oral communication), provide for adequate water for maintenance and justification of construction of an enlarged Tongue River Reservoir as described in the environmental statement in section I.B.1. It is highly unlikely, therefore, that the river flow, and thus the reservoir contents, will be sufficiently depleted in the foreseeable future to the extent that inadequate dilution of the ground-water discharge from the spoils aquifers would occur.
- 4 As described in section IV.B.6.d. "Environmental monitoring," the water quality of principal surface-water and ground-water sources would be continuously monitored throughout the life of the proposed operation. Any degradation in water quality should be detectable before impairment to water use becomes serious. Should this situation become a reality, the Company, in consultation with appropriate permitting and regulatory agencies, would identify the source and initiate necessary corrective measures.

LETTER 27

1

"MY NAME IS PAT SUART AND I AM ASSISTANT DIRECTOR OF THE MONTANA COAL COUNCIL. OUR ORGANIZATION IS HEADQUARTERED IN HELENA AND REPRESENTS FOUR OF THE FIVE PRODUCING STRIP MINES IN MONTANA (INCLUDING THE DECKER MINE), OTHER RESERVE HOLDERS AND SEVERAL ASSOCIATES.

I WISH TO MAKE IT CLEAR THAT I BELIEVE THE UNITED STATES IS IN A VULNERABLE POSITION NOW WITH SLOWED DEVELOPMENT OF OUR OWN ENERGY RESOURCES AND INCREASING DEPENDENCE ON FOREIGN OIL AND GAS SUPPLIES. THE APPROVAL OF DECKER'S PERMIT FOR INCREASED PRODUCTION WOULD BE A POSITIVE STEP IN RELIEVING SOME OF THAT DEPENDENCE.

BUT IN THIS INSTANCE, I FIND MYSELF WEARING TWO HATS. UNTIL SLIGHTLY LESS THAN FOUR MONTHS AGO, I WAS A RESIDENT OF SHERIDAN, WYOMING, AND WORKED AS A REPORTER FOR THE SHERIDAN PRESS.

FOR TWO YEARS, I FOLLOWED THIS COMMUNITY THROUGH THE PROCESSES OF PLANNING FOR IMPACT. MY NEWSPAPER, IN FACT, MADE A CONCERTED EFFORT TO ENCOURAGE AND REPORT ON THAT PLANNING. I HAVE, THEREFORE, BEEN WITH THOSE WHO SERVE ON THIS COMMUNITY'S BOARDS, COMMISSIONS AND COUNCILS WHEN THEY MET OFTEN AND LATE INTO THE NIGHT AND EARLY MORNING HOURS.

THESE PEOPLE HAVE DONE A GOOD JOB. THEY HAVE IDENTIFIED WHAT NOW IS AVAILABLE IN THIS COMMUNITY, WHAT IS NEEDED AND HOW MUCH IT WILL COST. THE RESULT HAS BEEN THAT THEY HAVE DISCOVERED THAT THEY HAVE MUCH TO OFFER, NEED MANY IMPROVEMENTS AND HAVEN'T THE FUNDS TO PAY FOR IT ALL.

IT IS BECAUSE I AM SO FAMILIAR WITH THE WORKINGS OF SHERIDAN AND SHERIDAN COUNTY THAT I WISH TO CONFINE MY COMMENTS TO THAT PORTION OF THE DRAFT EIS THAT DEALS WITH THE EFFECTS OF INCREASED COAL PRODUCTION ON SHERIDAN, WYOMING.

AFTER WITNESSING ALL OF THE EFFORT EXPENDED HERE BY LOCAL PEOPLE, I AM CONCERNED TO SEE THAT SHERIDAN'S IMMEDIATE FUTURE IS SO BLEAKLY FORECAST ON THE FIRST PAGE OF THIS EIS.

REFERRING TO ITEM "F" ON THAT PAGE, IT STATES UNDER THE HEADING, "SUMMARY OF ADVERSE, UNAVOIDABLE ENVIRONMENTAL IMPACTS," THAT "STATE AND LOCAL MONTANA GOVERNMENTS ARE CALCULATED TO HAVE SIZEABLE REVENUE SURPLUSES FROM THE PROPOSED MINES WHEREAS WYOMING GOVERNMENTS WOULD EXPERIENCE DEFICITS. QUICK RESOLUTION OF THIS PROBLEM IS UNLIKELY BECAUSE OF THE UNPRECEDENTED COORDINATION AND COOPERATION NECESSARY TO TRANSFER FUNDS FROM ONE OF THESE STATES TO THE OTHER."

1

Item "F" on the summary page of the DES represents a conclusion reached by the task force after appropriate economic analysis of the socioeconomic study area (Polzin, 1975). That conclusion was not based on the survey of the Sheridan area residents (Institute for Social Research, 1975) (see p. 477-479 and p. 631 of Volume I and p. G-56 to G-99, Appendix G, of Volume II of the FES). It was not the intent of the task force to portray a long-term hopeless economic situation for Sheridan, but rather to emphasize that little immediate hope exists for resolving the inequities between revenue surpluses in the Montana portion of the study area and revenue deficits in the Wyoming portion of the study area before the actual impacts from the Decker mine operations are felt by Wyoming residents.

WHILE THERE IS NO UNTRUTH TO PARTS OF THAT STATEMENT, I BELIEVE THERE HAVE BEEN SERIOUS OMISSIONS THAT COULD CHANGE THE CONCLUSION.

THAT CONCLUSION IS BASED ALMOST ENTIRELY ON ONE QUESTION IN THE SURVEY OF A SAMPLING OF SHERIDAN RESIDENTS. AFTER EXAMINING THE CONDITION OF SHERIDAN IN SOME DEPTH, I WOULD AGREE WITH THOSE SURVEY PARTICIPANTS WHO IDENTIFIED THE NEEDS HERE FOR ROADS, HOUSING, SCHOOLS, WATER AND SEWER FACILITIES, LAW ENFORCEMENT ASSISTANCE AND AID TO SENIOR CITIZENS ON FIXED INCOMES. AND I KNOW THE COSTS.

BUT LET'S LOOK AT THE ALTERNATIVES OFFERED TO THOSE PEOPLE PARTICIPATING IN THE SURVEY WHEN THEY WERE ASKED WHO SHOULD PAY.

BY FAR THE MAJORITY -- 58.3 PER CENT -- SELECTED THE ALTERNATIVE THAT SAID, "THE COAL INDUSTRY AND THE TWO STATES SHOULD JOINTLY HELP PAY THESE COSTS." ANOTHER 15.8 PER CENT SAID THE TWO STATES SHOULD PAY, 10.8 PER CENT THOUGHT THE PROBLEM WOULD TAKE CARE OF ITSELF THROUGH INCREASED EMPLOYMENT, TRADE AND TAX BENEFITS, 8.3 PER CENT SAID THE COAL INDUSTRY SHOULD PAY AND 6.7 PER CENT DECLINED TO RESPOND. NOBODY THOUGHT SHERIDAN SHOULD LEVY A SALES TAX.

GIVEN ONLY THOSE SAME CHOICES, I MIGHT COME UP WITH THE SAME ANSWERS.

BUT THAT IMMEDIATELY PUTS SHERIDAN'S SITUATION INTO THE REALM OF HOPELESSNESS.

AS IS CLEARLY POINTED OUT, THERE IS NO PLAN NOW THAT ALLOWS MONTANA TO POUR SOME OF HER CASH DERIVED FROM THE DECKER MINE INTO THE ALLEVIATION OF THIS BEDROOM COMMUNITY'S PROBLEMS. AND, FRANKLY, I DOUBT THAT MONTANA IS TOO DISTRESSED OVER THE LACK OF ANY SUCH PLAN.

ON THE OTHER HAND, THE COMPANY FEELS IT HAS DONE QUITE A LOT SINCE DECKER WORKERS ARE CUTTING DOWN ON UNEMPLOYMENT RANKS AND CONTRIBUTING PROPERTY AND SALES TAXES TO THE WELL-BEING OF THE COMMUNITY. AND THOSE WHO LIVE HERE KNOW THAT DECKER HAS GONE BEYOND THAT. THE COMPANY HAS CONTRIBUTED \$50,000 TO SHERIDAN COLLEGE, \$50,000 TO THE YMCA, \$10,000 TO THE SHERIDAN AREA PLANNING AGENCY AND IT DONATES TO ALMOST EVERY DRIVE THAT AIDS THE YOUTH OF THIS COMMUNITY.

SO THAT LEAVES ME WITH THIS ANALYSIS: THE CITIZENS OF SHERIDAN ALREADY HAVE GIVEN DEARLY OF THEIR TIME AND EFFORT, THE COMPANY HAS DONE ITS SHARE AND THE TWO STATES CAN'T WORK OUT A DEAL. BUT THIS EIS LEAVES AT LEAST TWO AREAS OF AID COMPLETELY UNEXPLORED.

THE DOCUMENT AT NO TIME ADDRESSES THE CAPABILITIES OF THE STATE OF WYOMING TO PROVIDE IMPACT ASSISTANCE.

Text revisions on p. 595-596 discuss possible methods for allowing communities like Sheridan to receive front-end impact monies from the State of Wyoming.

THE LAST I HEARD, SHERIDAN WAS STILL A TOWN OF WINING. AND WINING, BECAUSE OF ITS INCREASING MINERAL DEVELOPMENT IN OTHER AREAS, CERTAINLY STANDS TO REAP SOME TAX BENEFIT. INCLUDED IN THAT WILL BE AN ADDITIONAL \$11 MILLION THIS YEAR BECAUSE OF THE INCREASED RETURN OF MINERAL ROYALTIES TO THE STATES THAT NOW IS LAW.

IN CASE YOU MIGHT FEEL THAT I AM NAIVE ABOUT THIS PROSPECT FOR HELP, LET ME ASSURE YOU I'M NOT. MY EXPERIENCE AS A REPORTER HAS INCLUDED COVERAGE OF THE WYOMING LEGISLATURE AND I AM WELL AWARE OF THE SCRAPPING AMONG 23 COUNTIES WHEN IT COMES TIME TO DIVIDE THE PIE. THE FIGHT BECOMES DOUBLY DIFFICULT FOR SHERIDAN BECAUSE IT IS UNIQUE IN THIS STATE AS A BEDROOM COMMUNITY FOR A NEIGHBORING STATE.

HOWEVER, SHERIDAN RESIDENTS CAN HELP IN THIS FIGHT BY RATIONALLY AND UNEMOTIONALLY EDUCATING -- ON A YEAR AROUND BASIS -- THE OTHER CITIZENS OF THIS STATE. THEY CAN DO THIS THROUGH WHATEVER STATEWIDE VEHICLE THEY HAVE, BE IT CHAMBER OF COMMERCE, LEAGUE OF WOMEN VOTERS OR OTHERS.

AND STATE AGENCIES HAVE A RESPONSIBILITY TO GET THE MESSAGE ACROSS, TOO. IT'S NOT FAIR TO WAVE "BYE-BYE" TO THE LEGISLATORS WHEN THEY LEAVE FOR CHEYENNE AND EXPECT THEM TO SLAY THE DRAGONS IN STATE AGENCIES AND FROM OTHER WYOMING COMMUNITIES. THEY ARE ONLY FIVE OF A BODY OF 92.

NOW I COME TO THE AREA IN WHICH I MOST STRENUOUSLY URGE CONSIDERATION FOR AID. JUST AS IT IS NOT FAIR TO DUMP THE LOAD ON SHERIDAN, I SAY IT ISN'T FAIR THAT THE BURDEN SHOULD FALL ENTIRELY ON WYOMING, OR MONTANA OR THIS REGION.

NOWHERE IN THIS DRAFT EIS IS THERE MENTION OF FEDERAL AID FOR SHERIDAN. I AM NOT NAIVE ABOUT THIS POSSIBILITY EITHER. I KNOW WHAT HAS BEEN HAPPENING IN SHERIDAN. FIRST IT HAS HAD TO HIRE GRANTSMEN TO SEEK OUT AID FOR VARIOUS PROJECTS -- WHETHER IT BE SEWER AND WATER, DAY CARE, AIRPORT FACILITIES OR MENTAL HEALTH. AND IF THE GRANTS ARE RECEIVED, THEY ARE ON THE BASIS OF A 75-25 MATCH, 50-50 MATCH OR 90-10 ON A DECLINING SCALE. FINALLY, SHERIDAN CAN'T EVEN COME UP WITH THE MATCH.

I BELIEVE THE ATTITUDE IS WRONG. AS IT IS NOW, THE FEDERAL GOVERNMENT IS MAKING US PROVE OUR NEED BY COMING UP WITH MATCHING FUNDS. AND YET, IT SEEMS TO ME, WE HAVE SOMETHING THE NATION NEEDS. WE HAVE VAST SUPPLIES OF ENERGY IN OUR COAL RESOURCES AND I CONSIDER ENERGY A MATTER OF NATIONAL DEFENSE.

IT ALSO SEEMS THAT I'M NOT ALONE. OUR LEADERS HAVE AGREED ON MANY OCCASIONS IN RECENT YEARS AND PRESIDENT-ELECT CARTER HAS SAID THAT A NATIONAL ENERGY POLICY WILL BE A MAJOR PRIORITY OF HIS ADMINISTRATION.

Text revisions on p. 591-593 and p. 602-611 discuss possible Federal programs available for Sheridan residents, including monies available through the Department of Housing and Urban Development and the Farmers Home Administration and as a result of changes in the Minerals Leasing Act and the recent enactment of the BLM Organic Act.

In addition to those possible socioeconomic mitigating measures discussed on p. 590-611, the Sheridan Chamber of Commerce has recently organized an industry-backed committee that could provide a forum for discussion of industry-backed mitigating measures. This committee could stimulate discussions on (1) co-signing notes for employees, (2) providing industry monies for low-interest down-payment loans on homes, (3) for housing projects, and (4) the feasibility of home-site development on or adjacent to proposed company developments. The committee also could provide a forum for dialogue between industry and other members of the Sheridan community.

I THINK A NATIONAL ENERGY POLICY MUST TAKE THE ATTITUDE THAT DEVELOPMENT OF DOMESTIC ENERGY RESOURCES IS IN THE INTEREST OF NATIONAL SECURITY AND DEFENSE. AND ONCE THAT HURDLE HAS BEEN CLEARED, THE PRECEDENT FOR FULL FUNDING IS THERE.

THE FEDERAL GOVERNMENT, THROUGH CONGRESSIONAL APPROPRIATION, HAS NOT HESITATED IN THE PAST TO PROVIDE THE FUNDS TO RELIEVE IMPACT IN AREAS WHERE A MILITARY FACILITY IS DEEMED NECESSARY FOR NATIONAL DEFENSE. PUBLIC LAW 94-367, THE MILITARY CONSTRUCTION APPROPRIATIONS ACT OF 1977, HAS SET ASIDE VAST AMOUNTS FROM THE DEFENSE DEPARTMENT'S BUDGET FOR THIS FISCAL YEAR, INCLUDING NEARLY \$581 MILLION FOR ARMY CONSTRUCTION, NEARLY \$550 MILLION FOR THE NAVY AND \$788 MILLION FOR THE AIR FORCE.

A TOTAL OF \$41,396,000 HAS BEEN earmarked for "DEFENSE AGENCIES" AND THAT DESIGNATION IS TO FUND "ACQUISITION, CONSTRUCTION, INSTALLATION AND EQUIPMENT OF TEMPORARY OR PERMANENT PUBLIC WORKS, INSTALLATIONS AND FACILITIES FOR ACTIVITIES AND AGENCIES OF THE DEPARTMENT OF DEFENSE." I WOULD CALL YOUR ATTENTION TO THE WORD "ACTIVITIES" IN THAT PORTION OF THE LAW AND SUGGEST THAT MAINTAINING THE WELFARE OF SHERIDAN, WYOMING, COULD BECOME AN ACTIVITY OF THE DEFENSE DEPARTMENT.

LOOKING CLOSE TO HOME, MALMSTROM AFB AT GREAT FALLS RECEIVES CONSIDERABLE BENEFIT FROM THIS ACT. ALTHOUGH A COMPLETE BREAKDOWN WAS NOT IMMEDIATELY AVAILABLE, I WAS TOLD BY JIM FELEBAUM OF THE SENATE APPROPRIATIONS COMMITTEE THAT MALMSTROM IS TO RECEIVE \$90,000 IN 1976 FOR "EXTRAORDINARY MAINTENANCE AND SNOW REMOVAL" AND ABOUT \$2 MILLION FOR ROAD REPAIR AND MAINTENANCE. THIS IS A DIRECT APPROPRIATION, NOT MATCHING FUNDS, AND THE RESULT IS THAT GREAT FALLS DOESN'T HAVE TO COUGH UP THE CASH FOR IMPACT IN THE AREA.

SCHOOLS IN GREAT FALLS, THROUGH THE DEPARTMENT OF HEALTH, EDUCATION AND WELFARE, RECEIVE MONIES TO RELIEVE THE COSTS OF EDUCATING CHILDREN AFFILIATED WITH THE AIR BASE FACILITY.

ALL OF THIS MONEY IS BEING INVESTED IN THE INTEREST OF NATIONAL DEFENSE. YET WHERE WOULD WE BE IN DEFENSE WITHOUT ENERGY?

I WOULD LIKE TO SEE THIS DRAFT EIS AMENDED IN THE FINAL VERSION TO PUT RESPONSIBILITY WHERE IT BELONGS. SOME OF IT BELONGS WITH SHERIDAN AND SOME WITH THE COAL INDUSTRY. BUT THEY HAVE DONE THEIR PART. NOW I WANT TO SEE THE SAME EFFORT COMING FROM THE STATE OF WYOMING AND, PARTICULARLY, FROM THE FEDERAL GOVERNMENT.

I DON'T WANT TO SEE SHERIDAN, WYOMING -- A COMMUNITY THAT HAS PROVEN ITS PRIDE AND POTENTIAL -- LISTED SIMPLY AS THE VICTIM OF "ADVERSE, UNAVOIDABLE ENVIRONMENTAL IMPACT."



ANTHROPOLOGOS RESEARCHES INTERNATIONAL

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"Contract Anthropology and Archaeology"

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P. O. Box 1218

Livingston, Montana 59047

Larry A. Lahren, *President*

November 24, 1976

Director
Geological Survey
National Center
Mail Stop 108
Reston, Va. 22092

Brace Hayden
State of Montana
Department of Lands
Helena, Mt. 59601

Gentlemen:

This correspondence is submitted as a professional testimony in relation to the Draft Environmental Impact Statement for the East-Decker and North-Decker Extension Mines, Decker Coal Company, Bighorn County, Montana, and is concerned with the archaeological and historical evaluations of said document.

During the summer of 1976 my firm was contracted by the United States Geological Survey to evaluate the impacts of coal development on the cultural resources in southeastern Montana. One aspect of the contract required archaeological surface reconnaissance of the East-Decker and North-Decker Extension Mine areas in Bighorn County. As a result of this work we have located the following additional sites within the specific project area boundary:

1. Five ridgecrest prehistoric habitation sites.
2. Two stream terrace prehistoric open camp sites.
3. A network of stone lines (probably leading to a bison kill), rock cairns and stone circles.
4. One historic period homestead site.

In light of these additional site locations and their potential importance in relation to the various antiquities laws it is suggested that the statement "none of the archaeological sites found within the proposed East-Decker and North-Decker Extension

1 See text revisions on p. 297-303.

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Incorporated

- 1 areas appears to be of major significance" (page 288 of the EIS) is erroneous and is based on insufficient data. Furthermore, it is suggested that the entire East Decker and North Decker Extension Mine areas be subjected to a more comprehensive and thorough reconnaissance/test program to properly evaluate the cultural resources before the EIS is accepted.
- 2

Sincerely,

Larry A. Lahren

Dr. Larry A. Lahren
Archaeologist

- 2 See text revisions on p. 611-615. See also the letter from the State Historic Preservation Officer (Appendix I) and responses to letters 3, 6, and 7.

LAL/cs

LETTER 29

BURGESS & DAVIS

ATTORNEYS AT LAW
SHERIDAN, WYOMING
82801

TELEPHONE
307-872-2773
P O BOX 726

November 24, 1976

HENRY A BURGESS
RICHARD M DAVIS JR

THOMAS C WILSON
CHARLES R HART
KIM D CANNON
TIMOTHY S TARVER

Director
U. S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

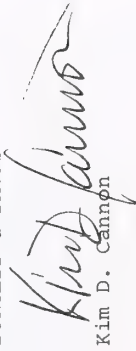
Dear Sir:

Enclosed please find "Statements of Residents of WYarno Community" submitted in response to the draft of the Environmental Impact Statement for the East Decker and North extension mines in Big Horn County, Montana. This Statement that is enclosed is identical to the one which was signed by some 58 residents of the WYarno community and submitted at the public hearing in Sheridan, Wyoming on November 18, 1976. The residents of the community have asked me to send a copy along to you to assure that this is included in the final draft of the Environmental Statement.

Thank you.

Yours very truly,

BURGESS & DAVIS


Kim D. Cannon

KDC/jl
Encl.

November 17, 1976

Statement of Residents of Wynarno Community

The Director
U.S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir:

The following statement is submitted in response to the Draft Environmental Impact Statement on the proposed plan of mining and reclamation for the East Decker and the North Extension Mines, Decker Coal Company, Big Horn County, Montana (DES76-40) (hereafter the "East Decker EIS").

I. THE EAST DECKER EIS FAILS TO CONSIDER THE ENVIRONMENTAL IMPACT OF COAL UNIT TRAINS ON SHERIDAN COUNTY AND PARTICULARLY WYOMING STATE HIGHWAY 336.

Perhaps because it was written in conjunction with the Montana Department of State Land, this EIS fails to adequately focus on problems south of the Montana-

- 1 Wyoming border (e.g. the cursory discussion of the impact on Sheridan Area Schools at page 464 does not consider how the additional needs will be met financially). One
- 2 impact never addressed in the EIS is the impact of the additional coal unit trains serving the East Decker and

1 See text revisions on p. 608-609 for a discussion of ways to mitigate impacts on Sheridan area schools.

2 See text revisions on p. 499-504.

2 North Extension Mines upon the main transportation arteries through eastern Sheridan County. The questions never addressed are: Is an underpass or overpass at the point where the spur to the Decker Mines crosses Wyoming State Highway 336 and joins the Burlington main line necessary to mitigate the impact of additional coal unit train traffic? Are underpasses or other types of safety devices necessary on the main Burlington Northern line where it crosses Sheridan County roads at WYarno and Ulm?

The short two-paragraph section which purports to deal with the impact of "long distance transportation of coal" (East Decker EIS at 471-472) clearly points up the draftsmen's failure to consider impact problems in Wyoming. This section states in part:

5 Rail traffic on the spur to the Decker Mines would more than double, thereby increasing existing impact proportionately. This spur runs through sparsely populated areas, however, and would significantly impact vehicular traffic only at the grade crossing of route FAS 314 near the West Decker Mine. East Decker EIS at 472. (Emphasis added)

When the same rail traffic which crosses FAS 314 also crosses Wyoming State Highway 336, how can FAS 314 be the only grade crossing which is impacted? Indeed, when one considers that the coal trains from the East Decker site

3 See text revisions on p. 619-621 for a discussion of a grade-separation structure where the Decker spur line crosses Wyoming State Highway 336 immediately north of the Burlington Northern main line. See also the correspondence from the Wyoming Department of Highways to the Montana Department of Highways (Appendix K) and the exchange of letters between the Powder River Basin Resource Council and Burlington Northern Inc. (attachments to letter 25, Appendix M).

4 See text revisions on p. 620-621 for a discussion of the need for grade-separation structures where the Burlington Northern Inc. main line intersects Sheridan County roads east of the city of Sheridan.

5 Train-traffic impacts from the proposed East Decker and North Extension mines are discussed on p. 380 and 437-438, respectively. Cumulative impacts of increased unit-train traffic are discussed in text revisions on p. 499-504. The latter discussion includes a description of projected unit-train traffic on the Decker spur line from both existing and proposed mines. The task force estimates (see table p. 503) that within the next decade approximately 200 trains per week (28.6 trains per day) would cross Wyoming State Highway 336 northwest of WYarno, given the projected coal production in the area that would be serviced by the Decker spur line.

will not cross FAS 314, but will cross Wyoming State

5 Highway 336, the impact on the latter seems significantly greater.

The cumulative impact of all the coal unit train traffic serving the area mines was never dealt with in the EIS in derogation of the direction of the National Environmental Policy Act and the case law arising under it. Why was a survey of that coal traffic not made and directly addressed in the East Decker EIS? Currently, the West Decker Mine is producing an annual rate of about ten million tons (East Decker EIS at 17) which requires between nineteen and twenty loaded coal unit trains per week to transport it. That figure is doubled when one considers the number of empty trains on their return trip. The East Decker and North Extension Mines will fill an additional seventeen unit trains per week according to the EIS (East Decker EIS at 471-472). The weekly total of empty and full unit trains just from the West Decker, North Extension and East Decker mines will be between 72 and 74—over ten trains per day.

This figure is only a part of the total rail traffic over the Wyoming State Highway 336 and the crossings over Sheridan County roads from coal traffic alone.

6 See text revisions on p. 499-504.

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In discussing rail traffic the draftsmen of this EIS omit mention of the unit trains which carry coal produced in the Big Horn Coal Company Mine in Acme and the coal expected to be produced from the proposed Whitney Mine and mines proposed by Shell Oil Company, Public Service Company of Oklahoma, Gulf Oil, Chevron, Consolidation Coal, Amax, Peabody and Westmoreland. Most, if not all, of the coal produced from this series of mines will be routed over the "Decker Spur" and across Wyoming State Highway 336 and the Sheridan County roads at WYarno and Ulm. The EIS does mention the Shell Mine with a projection that eight million tons of coal will be annually produced over twenty years. (See East Decker EIS at 79). This alone will require at least thirty additional coal trains (counting the empties). Additionally, there would be another thirty-five trains per week (counting empties) if the one hundred eighty-five million tons at East Decker not considered by this EIS, but which will "very probably" be mined (East Decker EIS at 74), were shipped by rail over a twenty year period.

The comment quoted above that the spur runs through "sparsely populated areas" is misleading. The focus of the EIS should not be the area which the spur

7 Your comments have been noted. See correspondence from the Wyoming Department of Highways to the Montana Department of Highways on p. K-10 and K-11, Appendix K.

runs through, but the area which is served by the Highway which the spur crosses. To say that an area is "sparsely populated" is inadequate. In Precinct 16 of Sheridan County whose polling place is the Wyrno Community Hall east of the railroad crossing on Highway 336, there are currently one hundred thirty-seven registered voters.

This figure does not include, of course, numerous farm workers who work, but do not vote, in this area. Additionally, it does not include the school age children of these registered voters all of whom must attend school in Sheridan and who must wait for and ride school buses which must cross the spur tracks at the grade crossings on Highway 336.

Another index of the number of people affected by increased coal train impact upon the highway and county road is the average daily traffic figures compiled by the Wyoming State Highway Department. On State Highway 336 from the junction with Interstate 90 to the Lower Prairie Dog road an average daily traffic figure of 540 vehicles was reported in 1975. The average daily traffic figure from that county road to Wyrno is 250 vehicles. Over the course of 365 days a year, the latter figure would be 91,250 vehicles.

More important than sheer numbers, however, is that Highway 336 is the only access the residents of eastern Sheridan County have to hospitals in emergencies and to schools. Furthermore, many ranchers, such as the eighteen members in the Peters Grazing Association regularly drive livestock along the road in taking their stock to summer range east or south of Wyarso or going up to the Big Horns to a mountain permit. Many of the herds of cattle and sheep take up to ten to twenty minutes to cross the railroad tracks in places which are extremely hazardous, particularly the grade crossing at the county road up the Dow Prong east of Wyarso. This hazard extends not just to the livestock, but to the men, women and children working the livestock and to the train crewmen.

II. THE EAST DECKER EIS MUST CONSIDER CONSTRUCTION OF AN OVERPASS OR UNDERPASS ON THE IMPACTED WYOMING CROSSING AS A NECESSARY MITIGATING MEASURE.

The failure of the East Decker EIS to consider the "impact" from the coal unit train movement through Sheridan County leads inexorably to its failure to consider underpasses and overpasses as necessary mitigating measures. Although the EIS does mention that ten per cent of the Montana coal-tax revenues are earmarked for the reconstruction of twelve segments of primary and secondary

See text revisions on p. 499-500 for a listing of cumulative impacts from increased rail traffic in conjunction with long-distance transportation of coal.

See responses 3 and 4 above.

Your comments have been noted. Interstate financial assistance from Montana to Wyoming would require that the Montana State legislature amend State laws to permit such payments. As the FES points up (p. 631), that action is not likely to occur in the near future. See p. 593-596 for a discussion of Federal and State funding that is available for community development in energy impacted areas.

highways in the coal-impacted areas of Big Horn, Rosebud and Treasure Counties (East Decker EIS at 558), no mention is made that not one cent is similarly available for highway construction in Sheridan County. Moreover, the matching federal funds are presumably not available when Sheridan County has nothing to match.

Significantly, the draftsmen do acknowledge that at least in one alternative circumstance (transportation of coal from East Decker to West Decker via truck) "a private haul road complete with a bridge over the Tongue River and an overpass or underpass at Route FAS 314"

(East Decker EIS at 710) would be required. Why is an overpass or underpass not required at Wyoming State Highway 336? What are the relative costs and benefits of such a

structure? Can the sellers of the coal not pass the cost of such an overpass on to their customers? How much of a cost may the coal producer impose on the residents of Sheridan County before it is required to construct something as elemental as an overpass? The severity of the impact of coal unit trains on Wyoming landowners has been recognized in other contexts. See generally In Re Burlington Northern, et. al. (construction of line between Gillette and Douglas) 348 I.C.C. 388 (1976).

10

11

12

See letter from Wyoming Department of Highways to the Montana Department of State Lands (p. K-10 and K-11, Appendix K) for an analysis of the need for a grade-separation structure at the location where Wyoming State Highway 336 crosses the Decker spur line.

11

Grade-separation structures at the highway crossing northwest of WYarno and at other principal at-grade crossings in the WYarno area would largely mitigate the adverse impact of unit trains on vehicular traffic, but not without cost. For example, the structure proposed by the Montana Department of Highways to mitigate the obstruction of traffic on Route FAS 314 by unit trains is estimated to cost in excess of \$400,000 (see p. K-7, Appendix K). Similar structures at rail crossings in the WYarno area probably would cost as much or more. The coal producers or railroads could pass these costs on to the consumers, but they are reluctant to do so because of an assumed competitive disadvantage. Whether a coal company, a railroad, or a highway agency assumes the cost of constructing grade-separation structures is dependent in part upon a site-specific determination of easement or property-control constraints. See also the response to comment 11 above.

12

The Director
U.S. Geological Survey
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In conclusion, we respectfully request that all federal action be deferred until the problems of transportation in eastern Sheridan County are addressed and solved by the construction of appropriate overpasses and underpasses.

Yours very truly,

13 This option is available for consideration by the Federal decision maker as he reviews the record.

LETTER 30

Statement by Vincent Paul Johnston, Chairman for Citizens For Orderly Energy Development (COED), November 18, 1976, 7:00PM, Sheridan Center Inn, Sheridan, Wyoming, before the Council Hearing on Environmental Impact Statement for the East Decker and North Extension mines, Decker Coal Company, Big Horn County, Montana.

Mr. Chairman and Board Members:

Although I spoke to you concerning the draft environmental statement at the Squirrel Creek School last night, I would like to take a few minutes tonight.

Most of us are not used to public meetings such as this and to prepare and present adequate, pertinent input is difficult.

At Squirrel Creek I spoke mostly as a father, businessman, and consumer who is concerned about:

1. Employment in this area for our friends and our children. Like most parents, I want to see business activity at such a level my children might be able to find employment and live here, rather than in some far away place.
2. I am concerned about a healthy business climate and orderly, steady growth so that I might enjoy the fruits of growth and prosperity, rather than the pains of impact on one hand and/or depression on the other.

Tonight, however, most of what I say will outline for you some of the thoughts of the members of COED.

We tend to have tunnel vision when it comes to reading and commenting on E.I.S. (Environmental Impact Statements). However, our world is such we can no longer think of or exist in our own little world.

Since the membership of COED is concerned about (1) Ever increasing utility costs, (2) Balance of payments, (3) Our ever increasing dependency on foreign oil and minerals, (4) Inflation and (5) National security; we think the final draft environmental impact statement should state in some way how the Decker mines contribute to alleviating or solving these impact problems.

COED is aware, as I am sure most everyone else is, that the Powder River Basin is probably the worlds largest energy source, and as time goes by this energy will and must be utilized. The sooner East Decker is given a permit the less impact there will be on the growth curve.

The role of the Decker mines in alleviating or solving some of these impact problems is discussed in section III.C.18., "Contribution to relief of the energy crisis." Also, see sections VIII.I.2. and VIII. J.1. which discuss the use of coal from the Decker area as a substitute for oil and gas and the importance of energy conservation. Both actions would tend to decrease the magnitude of our present energy crisis.

Our world has progressed to the point we must have both mining and agriculture (not just one or the other) and there is no way the resources in the Powder River Basin can ever be locked up.

COED feels the final draft should make note that farm prices and especially cow prices are and have held at dangerously low prices for some time. This is basically cattle country and removing a few acres for mining purposes is beneficial and not detrimental. By the time the U. S. or world market are ready for more cattle the land will be back in production.

COED members are not for returning the land to its original contours and original vegetation. Why not when possible, broaden and level the valleys so they can be farmed easier. Why not modify the hills so there is less erosion from wind and water. Why not where possible modify the hills so they might not be sprinkle irrigated. Why not reclaim some lands with ponds and increase our wet lands for water fowl. Why should we advocate the planting of sage brush when some government agencies and ranchers are paying millions to kill sage brush.

We are aware that the OPEC countries are meeting right now and deciding how much to increase the cost of oil. Not if there will be a price increase, but how much. By 1981 all natural gas imported from Canada will be stopped. So will the importation of other Canadian petroleum products. We are headed for an energy crisis and we think the Decker E.I.S. should state that these mines in their own little way will help solve this problem.

COED members know that this particular mine and the tax base thereof is in Montana while the service impact and problems of housing will be mainly with Sheridan. We are not so naive as to think we will not have some problems with temporary impact, but we find the benefit to cost ratio overwhelmingly in favor of the new mine. All we must do to get a cursory view of what the original Decker mine did for the people in Sheridan is to compare our business community today with the pre-Decker days--employment opportunities, business climate, improved medical services, Jr. College, to name just a few comparisons.

When the demand develops the contractors in Sheridan have and will build the houses to meet that demand.

Any housing problems we have are identical to housing problems in all other U. S. Cities, i.e., high interest rate and inflation caused by, among other things, energy shortages. It is not fair to blame housing shortages for the low income families on Decker, put the blame where it belongs.

Agricultural prices historically have been extremely volatile. Beef prices were at their maximum as recently as 1973. Although beef prices have declined somewhat below the 1973 highs, a new peak may occur long before the approximately 6,300 acres in the East Decker and North Extension project areas are utilized again for grazing livestock (see p. 630). Moreover, higher prices for livestock generally translate into higher prices for consumers. One cannot assume, therefore, that the removal of such acreage from beef production would be beneficial to all concerned over the life of the proposed operations.

Your comments have been noted. See discussion of alternate reclamation objectives and methods p. 815-820. Requirements of the Montana Strip and Underground Mine Reclamation Act relative to these comments are discussed on p. 520-521 and 570.

See section III.C.18., "Contribution to relief of the energy crisis." It should be noted that Canada proposes to eliminate exports of crude oil in 1982, not natural gas. Furthermore, recent reports by the Montana Environmental Quality Council and the Montana Power Co. indicate that eventual curtailment of Canadian natural gas, which probably will not occur until 1985 or later, may not be as serious a problem, at least for Montana, as originally feared by some.

Your comments have been noted.

High interest rates and inflation have depressed the national housing market. Increasingly, people are turning to multiple-family dwellings and mobile homes for housing. Elsewhere in the U.S., the housing shortage has been developing slowly over the last decade. In Sheridan, however, the shortage has occurred rather abruptly in response to coal-related activity.

The Sheridan community solved with zest the so called problem of Decker #1, and I have confidence they will meet and solve the problems, good or bad of East Decker with the same zest.

Vincent Paul Johnston

Vincent Paul Johnston

LETTER 31

Miki Straughan
155 Marion
Sheridan, Wyoming 82801
November 27, 1976

National Center
Office of the Director USGS
Mail Stop 108
Reston Virginia 22092

Dear Sir:

I have read the Proposed plan of mining and reclamation prepared for the East Decker and North Extension Mines of the Decker Coal Company, and have the following comments:

- 1) Estimates were used to arrive at a gross erosion figure, upon which these estimates were based to gain an average. This average may not be accurate for a single Decker Basin Area.
- 2) Air dust pollution is based upon 2 million tons of coal rather than the 6 million or 10 million which is the more likely.
- 3) Cumulative effects on the environment of all the mines in the area has not been considered.
- 4) There are many unknowns about the long-term damage to water quality and quantity where alluvial valleys are involved.
- 5) There is no mention of radiological contamination content being measured and recorded in compliance with regulations guiding interim rules.
- 6) The county and city of Sheridan will bear the brunt of rapid development, its' water and air degraded, wild-life endangered, health threatened with improper sewage treatment, while its' increased revenue will not be half that of the increase in expenditures.

Too often harm caused is minimized by those who will financially benefit or government which will have a stake in development while the harm to the land and the impact on the ordinary citizen -- those who have the least ability to protest.

Although strip mining will go forward in the NGP region, a priority should be set, limiting it to areas outside the alluvial valleys.

Sincerely
(Mrs.) Miki Straughan
Miki Straughan

Response to Letter 31

- 1 In the absence of data on sediment yield from watersheds in the Decker area, estimates of erosion and consequent sediment yield were made for each watershed using established procedures (see p. D-29 to D-35 and table D-12, Appendix D). Although these results may not be as accurate as actual sediment-yield measurements, they should be wholly suitable for the purposes of this statement.
- 2 Estimates of fugitive-dust emissions were obtained by the procedures described in Appendix C. The computations for the proposed North Extension mine, examples of which are presented in Appendix C of the DES, assumed an average annual production rate of two million tons per year; results of these computations are listed in table 41. Similar computations using the same equations were completed for the proposed East Decker mine and listed in table 36. To reduce the bulk of the environmental statement, the latter computations were not included in Appendix C. All computations in Appendix C of the FES have been checked and revised when necessary (see changed numbers in Appendix C and in tables 36 and 41).
- 3 The cumulative effects of the two proposed mines are discussed in section III.C. Where relevant, the added effect of the West Decker mine is included (e.g., see sections III.C.3.a.(5) and III.C.3.b.(3)). See that revisions on p. 439 regarding the inability of a site-specific EIS such as this to assess the cumulative effects on the environment of all mines planned in the area. Cumulative impacts of existing and proposed mines in the area should be adequately addressed in the Northern Powder River Basin regional EIS, which is currently under preparation.
- 4 The impacts to all aquifers in the Decker area, including those underlying alluvial valleys are discussed in sections III.A.3. and III.B.3.
- 5 See text revisions on p. 173.
- 6 See sections III.C.7., III.C.8., III.C.9., and III.C.10. for a discussion of impacts on Sheridan County and the city of Sheridan that would occur should the proposed Decker mines be approved. Sections IV.C.2., IV.C.3., IV.C.4., and IV.C.5. discuss possible mitigating measures for those impacts to the city of Sheridan and Sheridan County identified in section III.
- 7 Your comments have been noted.

U.S. Geological Survey
 Natural Center, Reston, VA 20192
 Four Mile Ranch
 Decker, Montana
 59025
 Nov. 26, 1976

Sir:

Further comments on the study of proposed strip mining North & East of Decker, Montana:

The study minimizes the damaging effects of strip mining to the land, the air quality & the all important water.

- 1 The air quality needs detailed monitoring now as it has already declined very badly.
- 2 The aquifers in the coal seams are the main source of spring water in this area.
- 3 Then how many wells be permanent. Without water how can the land survive?

The word "reclamation" as defined in the glossary has large loopholes.

- 4 Reclamation is being done. Reclamation at the land to its original natural resource is what is required.

- 1 Your comment has been noted.

Existing air-quality monitoring and results through 1976 are described on p. 108-109 and in tables 4A and C-4 and C-5, Appendix C. Proposed air-quality monitoring stations are described on p. 577-578, and locations are shown on figure 69A.

The effects of the proposed mines on springs and wells are discussed in sections III.A.3.a.(6), III.B.3.a.(6), and III.C.3.a.(7). Available data indicate that substitute supplies equally suited for domestic and livestock uses can be obtained from underlying coal beds (see section IV.B.3.a.(2)(a)). Most springs adversely affected by mining would very probably resume flowing after reclamation is completed. All interrupted water supplies must be replaced by the Decker Coal Co.

See text revision on p. 584. The Montana Strip and Underground Mine Reclamation Act and rules adopted pursuant thereto (Section 50-1045, R.C.M. 1947) require that lands strip-mined for coal be replanted to a permanent, diverse, and primarily native vegetative cover. The required capability of this replanted vegetative cover is described in response 4 to letter 23.

5 Railroad right of ways on line 2 show
must be adequately fenced against livestock.
1 must be kept clear by cutting a burning for
prevention of fires from trains.

6 Should Tongue River dam be heightened? The
companies involved must be held responsible
for damage should they occur.

7 To destroy the prime piece of agriculture
land shown to be destroyed for a
settling pond (P. 65) so very close to
Tongue River reservoir is utterly reprehensible.

Sincerely,
Ellen Cotton

5 See text revisions on impacts from train traffic (p. 499-500) and
mitigations (p. 619-621).

6 Your comment has been noted.

7 Approximately 437 acres of irrigated cropland would be taken out of
production when the North Extension area is fenced. The proposed
settling pond to be located in the midst of this premier cropland
would cover an area of about 20 acres. The settling pond would be
removed on completion of mining and the area reclaimed such that once
again the valley bottom would be suitable for use as irrigated cropland.

Box 164, Birney Rte.
Sheridan Wyo

Dear Sir:

The Decker mine is ruining the land and our community. Why should it be extended? we hear of an "Energy Crisis" while energy is being squandered as though there were no tomorrow.

¹ Billions of gallons of gasoline are being used for fun and games, if we ever need it for defense it will be gone so why tear up the land and use up all the fossil fuels now? Decker mine is a disaster

Sincerely
Mrs. Claude A. Peterson

¹ Your comments have been noted.

LETTER 34

November 22, 1976

Department of the Interior, U. S. Geological Survey
Montana Department of State Lands

Gentlemen:

This is a statement on my reaction to the environmental Impact Statement on the East Decker and north extension of Decker Coal.

My name is William G. Barbula. I am 46 years old, married and have five children. I am a member of the newly formed group, Citizens for Orderly Energy Development (COED).

We have ranched and farmed on our present property for the last thirty years. This ranch is, in fact, located just south of the Montana line on Wyoming Highway 338 which leads to Decker Coal Company mine.

First I would like to extend my congratulations to the Montana Department of State Lands for the fine job that was done on the EIS. It seems they did their best to include all the problems of impact that might come from the approval of such mines. I see no reason why these mines should not be approved. If there are problems in the area, I'm sure they are small and can be solved with the cooperation of all involved. One of the biggest and most important reasons for approving the mines is the fact that our nation is extremely short on energy and mining our coal is one of the fastest and surest ways to alleviate such a problem. Right now the OPEC nations are meeting to determine the amount of increase on the price of oil that they will impose on nations that import oil from them. So you can see that any delay in increasing the mining of the coal in the United States can be near fatal.

In attending the hearings on the FIS, I see no large problems which would call for a denial of the extension of the Decker coal activities in the Decker Montana area.

There was some concern about the agriculture land that would be lost to production with the increase in coal mining in the area. This loss in production is only short-lived as the FIS points out. The reclamation will take place as soon as the coal is removed.

As a rancher, it seems to me a little loss in production wouldn't hurt a thing at the present. Less production would help do away with the surplus food which is plaguing farm prices, not

Comments do not require a response.

allowing farmers to make a decent return on investment, or even to stay out of the red.

By the time this lost land would be back in production, maybe the country would need more food than it does now and farmers could again make a decent living on his land.

There was concern about the impact of people in the city of Sheridan. This was answered by a statement from the Sheridan Chamber of Commerce where they stated they were very happy to have the influx of people in their city. These people help make the business more profitable and competitive so it also helps the individual citizen to shop for better bargains with the increase in the number and quality of stores to shop from.

There was concern about the increase in traffic on the Decker road. This can be partially alleviated by paving other roads which lead to the various mines in the area. This, I understand, is already "in the mill" with money from Wyoming coal tax. This is one area where, I think - and it has been testified by other people - that Montana with its 30% tax could and should help the impact caused by the Decker mines in the Sheridan area.

In closing, I would like to say the EIS was very well written and I hope that the final draft will not be written in such a way that the mining permit might be denied.

Thank you.

William G. Parbula
Kirby Star Route Box 58
Sheridan, Wyoming 82801

Comments do not require a response.

APPENDIX N

PUBLIC HEARINGS--COMMENTS AND RESPONSES
ON THE
DRAFT ENVIRONMENTAL STATEMENT

APPENDIX N

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Public hearings--comments and responses
on the Draft Environmental Statement

Hearings on the Draft Environmental Statement for the proposed East Decker and North Extension mines were held at the following locations and times to provide adequate opportunity for public input as required by Federal and State regulations.

| <u>Location</u> | <u>Date</u> | <u>Hours</u> |
|------------------------------------------|-------------------|---------------------------------------------------------------------|
| Billings, Montana Ponderosa Inn | November 16, 1976 | 10:00 a.m. - noon 1:30 p.m. - 5:00 p.m. 7:00 p.m. - 9:00 p.m. |
| Decker, Montana Squirrel Creek School | November 17, 1976 | 7:00 p.m. - 9:00 p.m. |
| Sheridan, Wyoming Sheridan Center Inn | November 18, 1976 | 1:30 p.m. - 5:00 p.m. 7:00 p.m. - 9:00 p.m. |

A summary of relevant comments received at these hearings, together with appropriate responses, are presented herein. Written comments read into the record, copies of which were furnished the hearings panel or sent to the Director, U.S. Geological Survey, or the Commissioner, Montana Department of State Lands, are included in Appendix M and treated as written comments. To avoid possible confusion, reference is made in the following summary to all written materials submitted in conjunction with individual testimony. Where appropriate, the reader is referred to specific letters and responses in Appendix M. Relevant testimony presented at the public hearings and not included in written statements are as follows:

Testimony presented at Billings, Montana, on November 16, 1976

Harley Sorrels

Harley Sorrels introduced himself as a historian currently employed at the Chief Plenty Coups Museum at Pryor, Montana. His comments focused on

his concern for the protection of cultural resources in the Decker area. Substantive issues raised by Mr. Sorrels are as follows:

1. It must be demonstrated that the archaeological resources in the project areas have been properly documented and appraised in accordance with State and Federal laws and regulations designed to protect such resources.

Response: See text revisions, p. 611-615. See also responses to letter 6, Appendix M.

2. Although the DES reported evidence of significant cultural findings in the project areas, the study performed was not adequate in terms of intensity or size of area.

Response: See text revisions on p. 297-303, 375-377, 430-432 and 611-615. See also Appendices H and I.

3. A resurvey of the proposed East Decker mine area resulted in discovery of five sites not reported in the initial survey of the area. At least one of these five sites would currently meet criteria for the National Register.

Response: See text revisions on p. 297-303, 375-377 and 611-615. See also response to Letter 6, Appendix M and pages I-15 and I-16, Appendix I.

4. An intensive resurvey should be made of the entire area by someone that has adequate experience in plains archaeology. Such a person should preferably be at the Ph.D. level and

have adequate credentials such as membership in the Certified Society of Archaeologists.

Response: See text revisions on p. 611-615 and pages I-10 to I-16, Appendix I.

Frank Dunkle

Frank Dunkle spoke as a representative of the Resource Education Foundation, Helena, Montana. He indicated that his group had reviewed the DES and would submit in writing detailed comments and suggestions.

Response: No response is required (No written comments were received from Mr. Dunkle or from the Resource Education Foundation).

Testimony presented at the Squirrel Creek School, Decker, Montana, November 17, 1976

Ed Malenovsky

Ed Malenovsky introduced testimony as a representative of the Tri-County Ranchers Association, Birney, Montana.

1. Mr. Malenovsky submitted written comments which he read into the hearings record. Those comments appear as Letter 22, Appendix M.

Response: See response to Letter 22, Appendix M.

2. A point to be considered is the additional mileage that Birney residents must drive to get to Sheridan because of the proposed relocation of Route FAS 314. Sheridan is the main shopping center

for Birney residents, the site of hospital facilities, a source of agricultural supplies, etc. Birney residents would receive no compensation for the approximately 3½ miles of additional road distance that would have to be traveled as a result of mining in the Decker area. This is an added cost to Birney residents.

Response: Your comments have been noted. See discussion p. 434-437 and 807-812.

3. There are going to be about twice as many trains (approximately 60 empty and loaded a week) as there are now if the mines are approved. There are going to be two grade crossings if the East Decker proposal is approved. A petition requesting an overpass at the existing grade crossing has been sent to the State Highway Department.

Response: See text revisions on p. 380, 437-438, 499-504 and 619-621.

Jim Hamilton

Jim Hamilton, representing himself and not the school board of which he is a member, spoke of some benefits that the Decker School District had received from the Decker Coal Co.

1. Mr. Hamilton noted that the school district's tax base had increased, and mill levies had decreased since the Decker Coal Co. came into the area. Also, because of the increased tax base, the school district had been able to put a school bus into operation.

Response: Comments generally do not require a response. Changes in the mill levy for the school district are discussed in the response to comment 5 of Letter 22, Appendix M, and also p. G-29 to G-34, Appendix G.

2. Mr. Hamilton noted that the Decker Coal Co. had donated and poured a concrete slab for a basketball court at the Squirrel Creek School. He also mentioned that the Company had voluntarily mowed the weeds around the school house.

Response: Comments do not require a response.

Vincent Paul Johnson

Vincent Paul Johnson, a land owner on the Tongue River, a Sheridan businessman, and a father, spoke of how he expects the Decker mine expansions to affect these aspects of his life. Mr. Johnson also serves as the chairman of Citizens for Orderly Energy Development (COED) and spoke in behalf of that group. Because Mr. Johnson subsequently submitted written comments (Letter 30, Appendix M) at the hearing in Sheridan, Wyoming, only those substantive comments not repeated in his written testimony are presented below:

1. Energy development impacts that occur in sudden bursts, such as those that might be caused by a severe energy crisis, would be detrimental to the community of Sheridan. Gradual energy development, as exemplified by the proposed Decker mines would prevent such impacts and help maintain a prosperous climate for local business.

Response: Comment does not require a response.

2. Despite the fact that the tax base for the Decker mines is in Montana, the tax base for Sheridan, Wyoming, is growing. Many of the Decker mine workers spend their entire salaries in Sheridan. Such workers also purchase houses and other investments in Sheridan on which they pay taxes.

Response: Comment does not require a response. Relevant discussion is presented on p. 473-478 and 593-597.

Ellen Cotton

Ellen Cotton, a Decker area resident, expresses a number of concerns regarding the DES and coal mining in the Decker area. The most important comments were also submitted in writing (Letter 32, Appendix M). Those substantive comments not included in Ms. Cotton's written testimony are discussed below:

1. The name Gregg Penson is misspelled on p. 21 of the DES.

Response: See text revision, p. 25.

2. I have complained bitterly about the original relocation of Route FAS 314, but the Highway Department never answered my letters.

Response: Concerns of residents of the Decker area regarding the relocation of Route FAS 314 were noted by Robert Hall, Montana Department of Highways, who was present at the hearings. The Highway Department subsequently held

a public meeting at the Squirrel Creek School on January 12, 1977, to obtain public input regarding the highway relocation. A summary of that meeting is presented on p. K-1 and K-2, Appendix K.

3. An underpass should be constructed where Route FAS 314 crosses the railroad track near the West Decker mine. Sometimes the warning light at the crossing malfunctions and turns on when no train is in sight. One night a car-train collision occurred at the intersection. Road engineering in the vicinity of the intersection is bad. Will an underpass or overpass be constructed?

Response: See text revisions on p. 380, 499-504 and 619. See also p. K-1 to K-10, Appendix K. The Montana Department of Highways has approved a project to construct a railroad underpass at this crossing.

4. Is the East Decker mine a new mine or a continuation of the original Decker mine?

Response: For the purposes of the environmental statement, the East Decker mine is considered to be a new mine. The Decker Coal Co., however, was "grandfathered" out of the Montana Strip Mine Siting Act, and thus, statutes do not require that the Department treat the East Decker proposal as a "new mine." See response to comments 9 and 13, Letter 23, Appendix M).

5. Is the water quality of the Tongue River being monitored continuously, both for discharge from the mine and for pollution from habitation upstream?

Response: The quality of water discharged from the West Decker mine is monitored continuously by the Department of Health and Environmental Sciences as required by Montana statutes and regulations. The quality of water in the Tongue River is measured quarterly by the U.S. Geological Survey; no continuous monitoring of water quality is currently being done on the Tongue River in or adjacent to the Decker area.

Bill Woessner

Mr. Woessner introduced testimony on behalf of himself and as a representative of the Northern Cheyenne Tribe, Lame Deer, Montana. His written comments were subsequently sent to the Director, U.S. Geological Survey. See Letter 26, Appendix M, and response to that letter.

Eric Metcalf

Mr. Metcalf spoke as a representative of the Northern Cheyenne Tribe, Lame Deer, Montana. His questions all addressed the issue of air quality.

1. With regards to the East Decker and North Extension areas, are there going to be changes in the mining practices so that impacts to air quality are minimized to a greater extent than at the existing West Decker and Colstrip mines?

Response: See text revisions p. 564-570 and p. 764.

2. In the summer of 1976, mining operations at Decker and at Colstrip were found by the EPA to be in violation of the lowest standards of air quality in the United States.

Response: The Decker area has recently been designated by the EPA as an Air Quality Maintenance Area (see Federal Register, Vol. 41, no. 86, Monday, May 3, 1976). That designation means that either violations of air-quality standards have been recorded or that growth projections indicate possible violation levels by 1985. For further discussion, see p. 564. See also text revisions on p. 106-116 and 564-570.

Mrs. Harvey Porter

Mrs. Harvey Porter, an area resident who lives about 15 miles northeast of Decker, emphasized train-traffic problems and inquired about the authority of State and Federal agencies to require construction of an overpass or underpass at railroad crossings.

1. Do you people have any jurisdiction over the railroad or highway such that an overpass may be constructed at the intersection of the West Decker rail spur and Route FAS 314?

Response: The Montana Highway Department has approved a project to construct a railroad underpass at this crossing. The project has been added to the Highway Department's five-year construction program. See text revisions, p. 619-621

and K-1 to K-10, Appendix K. Neither the MDSL nor the U.S. Geological Survey, have such jurisdiction, however.

2. Do you people approve the mining plans for the East Decker and North Extension proposals?

Response: See p. 5-13 for a discussion of agency responsibilities. See p. 509 for a discussion of the purpose of an environmental statement.

Jim McCarthy

Mr. McCarthy, a Decker resident and owner of the Decker store and Post Office, commented on several impacts introduced by coal mining in the Decker area.

1. With all the coal-tax monies generated by the Decker Coal Co.'s mine, Company employees and Decker area residents deserve a good paved road between the mine and the Wyoming State line. This section of road is dangerous, especially during the winter and during periods of shift change at the West Decker mine.

Response: The segment of Route FAS 314 extending southward from West Decker mine to the Wyoming state line is currently under analysis as part of the road improvement program to be financed by Montana Coal Severance Tax monies. That analysis is currently in the preliminary engineering stage for road upgrading.

2. An underpass should be built at the intersection of Route FAS 314 and the West Decker spur line. The cost of constructing such a structure should be borne by the State of Montana and not by the Decker Coal Co.

Response: See text revisions, p. 380, 499-504 and 619. See also p. K-1 to K-10, Appendix K. The Montana Highway Department has approved a project to construct a railroad underpass at this crossing. The project has been added to the Highway Department's five-year construction program.

3. Decker area residents have attended Highway Department meetings at Decker at which time they spoke of the need for road improvements and for a railroad underpass in the Decker area. Decker area residents have also written letters to the Highway Department in which they repeated such complaints. No replies to these letters have been received.

Response: See response to comments 1 and 2 above. Also, see text revisions, p. 619 and p. K-1 to K-10, Appendix K.

4. Decker Coal Co. employees pay income taxes to Montana, yet take all their money into Sheridan, Wyoming, where there is no tax base for such money. What is going to happen to the people in Sheridan?

Response: See p. 473-479, 596-597 and 631. See also the response to comments 2 and 3 of Letter 27, Appendix M.

Testimony presented at Sheridan, Wyoming, November 18, 1976

Robert Murray

Mr. Murray, a historian and a consultant to the Decker Coal Co., introduced testimony regarding the archaeological and historical studies completed in the proposed mine areas. Comments very similar to those presented at the hearing are stated in a letter from Mr. Murray to Mr. Jack Reed, Peter Kiewit Sons' Co., dated November 19, 1976. That letter is reproduced on p. I-4 and I-5, Appendix I. Substantive issues raised by Mr. Murray at the hearing are as follows:

1. The Fredlund study was carried out properly and efficiently and extracted the maximum amount of reasonable archaeological data from the survey.

Response: See text revisions p. 611-615, revisions to Appendix H, and p. I-8 to I-16, Appendix I.

2. Total recovery of every shred of archaeological data is not necessary to adequately inventory and appraise the archaeological resources of the East Decker and North Extension areas. Some of the best archaeologists in the country do not feel that total data recovery is either economically feasible or professionally relevant.

Response: See text revisions p. 357-377, 430-432, 494-495, 611-615, and revisions to p. I-8 to I-16, Appendix I.

3. Systematic archaeological sampling, which assures a low probability of accidentally destroying a major site, is the goal of an archaeological survey such as that performed for the proposed Decker mine areas. This procedure, together with good statistical analysis, has added greatly to the knowledge of prehistoric man in the area. Total data recovery would not add much more information.

Response: Your comments have been noted. See also p. I-8 to I-16, Appendix I.

4. Harvey Sorrels' testimony at the public hearings in Billings on November 16, 1976 was prompted by results of an archaeological survey in the Decker area performed by Larry Lahren. We do not, at this time, know what Mr. Lahren's data consisted of and whether or not the sites he discovered were within the proposed Decker project areas.

Response: See text revisions p. 297-303 and table 33B.

William Laya

Mr. Laya spoke on behalf of the Sheridan County Commissioners of which he is chairman. Mr. Laya, who resides in Dayton, Wyoming, submitted written testimony which he read into the hearings record. His comments appear in Appendix M as Letter 22.

Response: See responses to Letter 18, Appendix M.

Tom Adsit

Mr. Adsit, a Decker area rancher, stressed the need for an overpass at the intersection of Route FAS 314 and the West Decker spur line because of projected increases in rail traffic. Mr. Adsit also stated that on a recent night he had almost been struck by a train at the crossing because the signal lights weren't working.

Response: See text revisions, p. 380, 499-504, and 619. See also p. K-1 to K-10, Appendix K.

Stanley Olsen

Mr. Olsen of Dayton, Wyoming, President of the Sheridan County Chamber of Commerce, submitted written testimony which he read into the hearings record. His comments appear in Appendix M as Letter 22.

Response: See responses to Letter 22, Appendix M.

Tom Neighbors

Mr. Neighbors, a resident of Sheridan and a Sheridan businessman stated that increased mining activity would have a favorable impact on Sheridan business. Mr. Neighbors expected to receive additional business sales in the future as a result of the Decker mine proposals.

Response: No response is required.

Mrs. Pat Stuart

Mrs. Stuart spoke on behalf of the Montana Coal Council of which she is assistant director. The Montana Coal Council is headquartered in Helena,

Montana. Mrs. Stuart submitted written testimony which she read into the hearings record. Her comments appear in Appendix M as Letter 27.

Response: See responses to Letter 27, Appendix M.

Leonard Brownell

Mr. Brownell presented testimony on behalf of the community of Wyarno, Wyoming, which is located about eight miles east of Sheridan. All of the comments raised in Mr. Brownell's oral testimony were also submitted as written comments and are included as Letter 29 in Appendix M.

Response: See responses to Letter 29, Appendix M.

Bud White

Mr. White spoke on behalf of 5,500 members of the Operating Engineers, Local 400 in Montana. Mr. White urged the task force to write an environmental analysis that was favorable to his union. He stated that in addition to operating enigneers, others involved in the Decker Coal Co. mine operations included those in Sheridan and Billings who sell oil, tires, parts and "everything."

Response: No response is required.

Tom France

Mr. France, spoke as a representative of the Powder River Basin Resource Council. Mr. France submitted written testimony which he read into the hearings record. His comments appear as Letter 24, Appendix M.

Response: See responses to Letter 24, Appendix M.

Clarence Terry

Mr. Terry, a Sheridan County resident, spoke in support of coal mining in the Sheridan area. Mr. Terry pointed out that on his ranch, Federal coal has been burning underground for many years, and this has caused air pollution comparable to that at Colstrip, Montana. He also stated that the subterranean coal fires in the Sheridan area were responsible for a range fire 4 years ago.

Response: No response is necessary.

Vincent Johnston

Mr. Johnston, a Sheridan businessman, spoke on behalf of an organization entitled "Citizens for Orderly Energy Development" (COED). Mr. Johnston submitted written testimony which he read into the hearings record. His comments appear in Appendix M as Letter 30.

Response: See responses to Letter 30, Appendix M.

Ed Swartz

Mr. Swartz, a Gillette Wyoming rancher and the chairman of the Board of Directors of the Powder River Basin Resources Council made several substantive comments regarding the impacts of the Decker mine proposals.

1. Socioeconomic impacts upon Sheridan are being caused by the activities of a private company and that company, not the Federal government, should mitigate these impacts.

Response: No response is required.

2. A private industry that is making money for itself is going to have to provide a separate grade crossing and also help mitigate those problems associated with schools.

Response: Your comments have been noted. See text revisions p. 608-609 and 619-620. See also responses to comment 5, Letter 22, response to comment 3, Letter 27, and testimony presented by Jim Hamilton at the Squirrel Creek School hearings.

3. Energy company monies would be better utilized if they were spent on developing alternative sources of energy rather than attempting to mine every ton of coal that the nation has.

Response: Your response has been noted. See p. 830-840, for a discussion of alternate energy sources.

4. As in the city of Sheridan, there are also houses for sale in the city of Gillette, Wyoming; however, houses in Gillette that were selling for \$20,000 in 1971-73 are now selling for \$46,000. The average working man cannot afford such a price.

Response: Your comment has been noted. See text revisions, p. 602-607, for a discussion of mitigating measures to housing problems. See also response 3 to Letter 27.

Gerald Moravek

Mr. Moravek, who lives north of Sheridan and who is a member of both the Citizens for Orderly Energy Development and the Powder River

Basin Resources Council, made the following substantive comments regarding impacts related to energy development.

1. A traffic problem exists on Wyoming Highway 338, which runs northward from Sheridan to the Wyoming border and over which most people commute to work at the Big Horn and West Decker mines from the Sheridan area. This problem is aggravated because shift changes occur at the Big Horn and West Decker mines at the same time. In other areas industry has mitigated such problems by staggering their shifts slightly to avoid excessive traffic.

Response: Efforts by the Big Horn Coal Co. and the Decker Coal Co. are being made constantly to reduce traffic on Wyoming Highway 338. Owing to the distance between the mines, shift staggering is not a critical issue. The companies, do, however, encourage car pooling and the use of common transportation whenever possible.

2. The Decker Coal Co. should look into the safety problem created when red shale is kicked onto the road surface of Wyoming Highway 338 at the entrance to the Big Horn mine.

Response: The road entrance discussed here is for a new mine access road surfaced with crushed clinker (red shale). The problem should be short-term. Less clinker will be thrown onto Highway 338 in the future as these surface materials are incorporated into the roadway by use

and maintenance with a road patrol. No similar problem is anticipated in conjunction with the proposed mines.

3. A safety problem exists at railroad crossings in the area. Furthermore, highway traffic is tied up constantly at rail crossings in the Clearmont - Wyarno area.

Response: See discussion of train-traffic impacts on p. 380, 437-438 and 499-504. See also the discussion of possible mitigations to such impacts (p. 619-621).

APPENDIX 0

CORRESPONDENCE REGARDING
COMPLIANCE OF PROPOSED MINE PLANS
WITH REQUIREMENTS OF 30 C.F.R. 211.10(c)



United States Department of the Interior

GEOLOGICAL SURVEY
Conservation Division
P. O. Box 2550
Billings, Montana 59103

Montana 073093

February 11, 1977

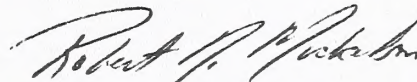
Memorandum

To: Tom Friz, Conservation Division,
U.S. Geological Survey - Mail Stop 651,
Reston, Virginia 22092

From: Mining Engineer, Northern Rocky Mountain Area

Subject: Mine Plan - Coal Lease Montana 073093, Decker Coal Company

Please find the enclosed mine plan checklist for the East Decker Mine concerning the subject coal lease. Additional maps and overburden analyses will be submitted by the company shortly. We have reviewed the East Decker mine plan and find that it meets the requirements of 30 CFR 211.10(c) to our satisfaction.


Robert N. Mickelson

Enclosure





United States Department of the Interior

GEOLOGICAL SURVEY

Montana 057934

Conservation Division
P. O. Box 2550
Billings, Montana 59103

March 2, 1977

3/8/77

Memorandum

To: Andrew Bailey, Chief, Branch of Mining Operations,
Reston, Virginia - Mail Stop 620

From: Deputy Area Mining Supervisor

Subject: Mine Plan - Coal Lease Montana 057934,
Decker Coal Company

We have reviewed the Decker North Extension mine plan and find that it meets the requirements of 30 CFR 211.10(c) to our satisfaction.

Douglas H. Hileman
Douglas H. Hileman

Enclosure (Coal mining plan
checklist)





